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ECOLOGY AND SUSTAINABLE DEVELOPMENT

MINISTRY OF EDUCATION AND SCIENCE
OF REPUBLIC OF KAZAKHSTAN

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The manual is based on the standard curriculum of the discipline "Ecology and Sustainable Development" approved by the Ministry of Education and Science of the Republic of Kazakhstan for students of higher educational institutions in Russian and English programs.

The manual contains theoretical material, terminological dictionary, test questions and test tasks that presuppose the independent work of students

The manual is recommended for the classroom and extracurricular work of full-time and distance-learning students.

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CONTENT

INTRODUCTION

The manual is intended for university students studying the "Ecology and Sustainable Development" discipline from the cycle of the compulsory discipline component.

The manual was implemented in accordance with the State Educational Establishment of the Republic of Kazakhstan on the basis of current curriculum of the Ecology specialty - 5B060800.

This educational and manual on the discipline "Ecology and sustainable development" developed in accordance with the standard and working curriculum, allows the student to obtain general information about the direction of the training course, and contains the teaching program and materials on the discipline. It determines the content of student's independent work in classroom andduring extracurricular time, allows to activate cognitive and creative activity of students and ensure the interrelation of educational and research processes.

The manual "Ecology and Sustainable Development" has been prepared in accordance with the State Educational Standard of Higher Professional Education compiled in Russian and Englishlanguages.

The need for knowledge of several languages in the modern world and the demand for a multicultural personality in modern society are obvious, and becomes a motivation in learning. This is due to the fact that multilingual education is inextricably linked with the implementation of the main parameters of the Bologna Process, the correlation and unification of curricula with the European standards of education. The main mechanism for practical implementation should be the principle of "double entry of knowledge": language education through the study of the linguistic disciplines themselves and the teaching of individual, in this case, natural-science disciplines in foreign and Russian languages.

The purpose of the manual is to make the understanding of the problems and results of research in the natural sciences accessible for students, to acquaint students with the most important concepts, the concepts of the sciences about nature in its interconnection and development.

At the end of each chapter, there are questions forstudent' self-examination. The manual lists the literature used in writing the manual and recommended to students in preparation for practical classes, as well as test tasks. The manual contains theoretical material, control and test questions, glossary, and bibliography. This manual is distinguished by the novelty of the content. The theoretical part of the manual is based on fundamental knowledge about the features of the structure and functioning of the environment system There are domestic and foreign authors researches are used in this manual.

THEME 1. INTRODUCTION. ECOLOGY AND PROBLEMS OF MODERN CIVILIZATION

1.1 Definition of ecology as a science, purpose, tasks and methods of ecology

1.2 History of development of ecology, three main stages of its development

1.3 Formation of ecological knowledge and culture

1.4 Definition of the term "Sustainable development" and the role of ecology in the implementation of the concept of sustainable development

Definition of ecology as a science. Purpose, tasks and methods of ecology

Ecology - one of the relatively young and rapidly developing sections of biology - is studying the interrelationships of organisms among themselves and with their habitat.

The term "ecology" (from the Greek oikos - dwelling, habitat and logos-science) was proposed by E. Haeckel in 1866 in his book "The general morphology of organisms" and in literal translation from Greek denotes science or housekeeping. This way Haeckel named the science studying the organization and functioning of superorganismic systems of different levels: species, populations, biocenoses (communities), ecosystems (biogeocenoses) and the biosphere. Originally this term was applied when it was a question of studying the relationships between plant and living communities representing stable and organized systems that evolved in the evolution of the organic world and the environment.

During the first decades of this century, the word "ecology" was used very narrowly. For most, it remained unknown. The concepts associated with this term have not yet become relevant and necessary. In the volume "The Development of Biology in the USSR" (1967), published to the 50th anniversary of Soviet power, the section "ecology" is missing. In the Encyclopedic Dictionary (published by TSB, 1955), ecology is defined as the "science of the mutual influences of the organism (animal or plant) and the environment", but the Encyclopedic Dictionary (published by TSB, 1964) gave a detailed definition, however the ecology only appeared as Sections of zoology and botany. In the Small Soviet Encyclopedia (1960), animal ecology and plant

ecology are devoted to individual articles. Thus, in the first half of the twentieth century, ecology did not go beyond solely biological research. It didn't cover human problems at all, as well as the protection of the environment.

There are many definitions of ecology as a science, but the overwhelming majority of modern researchers believe that ecology is a science that studies the conditions of living organismsexistence and the relationship between organisms and the environment they livein. The concept of ecology is very extensive, therefore, depending on the emphasis on a particular task, the formulation itself is changing. For "long-term use" the best definition can be, for example, the following: "Ecology is the biology of the environment."

Competing with each other in accuracy and short formulations, the authors forget that even Ernst Haeckel gave this science an exhaustive definition: "By ecology we mean the amount of knowledge related to the economy of nature: the study of the totality and relationship of the animal with its environment, both organic and inorganic, and in the first place - its friendly or hostile relations with those animals and plants which directly or indirectly come into contact.» In one word, ecology is the study of all the complex relationships that Darwin called the conditions that give rise to the struggle for existence.

The subject of ecology is the totality or structure of connections between organisms and the environment. The main object of study in ecology is the ecosystem, i.e. Unified natural complexes formed by living organisms and habitats. In addition, in the field of its competence includes the study of individual species of organisms (organism level), their populations, i.e. A set of individuals of one species (population-species level) and the biosphere as a whole (the biosphere level).

Currently, the ecology of various disciplines is rapidly developing, which is understood as the process of steady and consistent implementation of systems of technological, management and other solutions that allow increasing the efficiency of natural resources and conditions, along with improving or at least preserving the quality of the natural environment at the local, regional and global levels. There is a concept and ecologization of production technologies, the essence of which is the application of measures to prevent the negative impact of production processes on the natural environment. The implementation of the ecologization of technology is produced by the development of low-waste technologies or technological circuits that give a minimum of harmful emissions at the output.

In connection with this, ecology has broken up into a number of scientific branches and disciplines, far from the initial understanding of ecology as a biological science of the relationship of living organisms with the environment.

Depending on the problems to be solved, the ecology is divided into a general, exploring the basic principles of organization and functioning of various superorganismic systems, and a private one, the sphere of which is the study of specific groups of a certain taxonomic rank. The population ecology studies a populations – the totalities of one class of individuals combined by common territory and gene pool. The ecology of communities explores the structure and dynamics of nature communities i.e.the summation of different classes of populations that live together. Synecology is a section of general ecology that studies ecosystems.

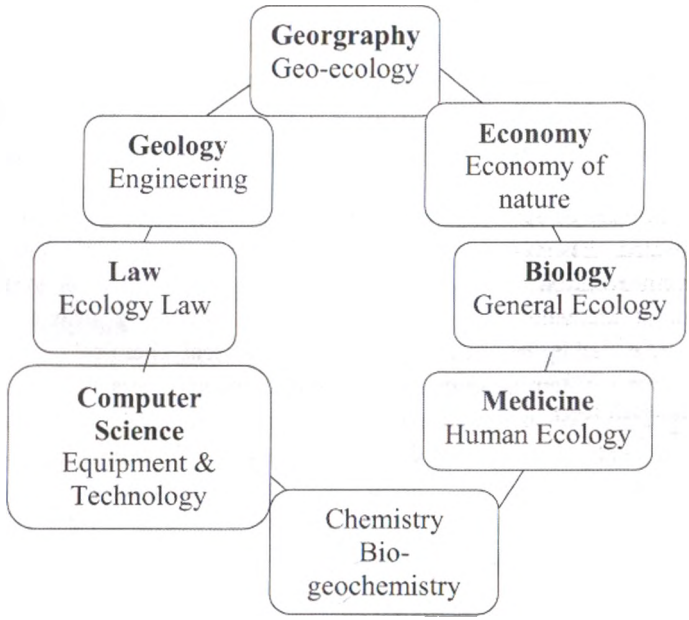


***Figure1**- Relationship of ecology with other sciences*

The ecological problems of the Earth as well as planet problems are being engaged in by actively developed global ecology,its main object of study is the biosphere as a global ecosystem. Currently,there are appearedsuch special disciplines as social ecology, which studies the relationship in the system

"human society - nature", and its part - human ecology (anthropoecology), which examines the interaction of man as a biosocial creature with the surrounding world.

Modern ecology is closely connected with politics, economics, law (including international law), psychology and pedagogy, since only by its conjunction it is possible to overcome the technocratic paradigm of thinking, which characteristic of the 20th century, and develop a new type of ecological consciousness that fundamentally changes people's behavior in relation to nature.

From the scientific and practical point of view, the division of ecology into *theoretical* and *applied* is quite justified.

Theoretical ecology reveals the general laws of the organization of life.

Applied ecology studies mechanisms of biosphere destruction by human, ways to prevent this process and develops principles of rational use of natural resources. The scientific basis of applied ecology is the system of general ecological signs, rules and principles.

Ecology as a science considers systems, parts of which are closely interconnected. Therefore, when analyzing environmental phenomena and planning interventions, many factors need to be considered. A system is a collection of elements that are connected and interacting with each other. Systems are called by its elements: physical, biological, chemical or mixed. The structure of the system depends onthe way of elements interaction, which leads to the appearance of its new characteristics - emergence. There are three types of systems: enclosed – these do not exchange with neighboringoneseither substances or energy; Closed – producing only energy exchange; Open - which do exchange with neighboring ones bothsubstance and energy. Almost all natural ecosystems belong to the open type.

The *main* tasks of ecologycan be directed to studying the dynamics of populations, to the doctrine of biocenoses and ecosystems. The structure of biocenoses, at the level of formation of which the environment is being developed, contributes to the most economical and complete utilization of vital resources. From this point of view, the main theoretical and practical task of ecology is to discover the laws of these processes and learn how to manage them in conditions of inevitable industrialization and urbanization of our planet.

The *strategic* task of ecology is the development of the theory of interaction between nature and society on the basis of a new view that views human society as an integral part of the biosphere.

Thereby, ecology becomes one of the most important sciences of the future and "perhaps the very existence of man on our planet will depend on its progress" (F. Dre, 1976).

The history of ecology development and three main stages of the development. Ecology has its roots in the distant past. The need for knowledge that determines the "attitude of an animal to its organic and inorganic environment" arose a very long time ago. It is sufficiently to recall the works of Aristotle (384-322 BC), Pliny the Elder (23-79 AD), R. Boil (1627-1691), etc., where was discussed the significance of the habitat in the life of organisms and the confinement them to certain habitats to make sure in this.

There are three main stages that can be distinguished in the history of ecology development.

The **first stage** is the incipience and development of ecology as a science (until the 60s of the nineteenth century). At this stage, the data on the interconnection of living organisms with the environment from the habitatwere accumulated, the first scientific generalizations were made.

In the XVII-XVIII centuries the environmental information accounted for a significant share in many biological descriptions (A. Reaumur, 1734, A. Tremblay, 1744, etc.). Elements of ecological content in the studies of Russian scientists Lepekhin, A.F. Middendorf, S.P. Krashennikov, the French scientist J. Buffon, the Swedish naturalist K. Linnaeus, the German scientist G. Jaeger, and others.

During the same period, J. Lamarck (1744-1829) and T. Malthus (1766-1834) for the first time are warning humanity of the possible negative consequences of human impact on nature.

The **second stage** is the formalization of ecology in an independent branch of knowledge (after the 60s of the nineteenth century). The beginning of the stage was marked by the release of works by Russian scientists K.F. Rulieu (1814-1858), N.A. Severtsova (1827-1885), V.V. Dokuchaev (1846-1903), that for the first timehave justifieda number of principles and concepts of ecology, which have not lost their significance to the present time. It is not an accident that the American ecologist J. Odum (1975) considersthat V.V. Dokuchaev was one of the founders of ecology.

In the late 70's. XIX century German K. Möbius (1877) introduces the most important concept of biocoenosis as a natural combination of organisms under certain environmental conditions.

An invaluable contribution to the development of the foundations of ecology was made by Charles Darwin (1809-1882), who revealed the main factors in the evolution of the organic world. What Darwin called the "struggle for existence", from the evolutionary point of view, can be treated as the relationship of living beings with the external, abiotic environment and with each other, i.e. with a biotic environment.

As an independent science, ecology finally took shape at the beginning of the 20th century. During this period, the American scientist Charles Adams (1913) had created the first ecology report, other important generalizations and summaries were published (Shelford, 1913, 1929; Ch. Elton, 1927; R. Hesse, 1924; K. Runker, 1929 and Other). The largest Russian scientist of the twentieth century V.I. Vernadsky creates a fundamental doctrine of the biosphere.

In the 30's and 40's. ecology had risen to a higher level as the result of a new approach to the study of natural systems. First A. Tensli (1935) put forward the notion of an ecosystem, and a little later VN. Sukachev (1940) substantiated the similar idea about biogeocenosis. It should be noted that the level of domestic ecology in the 20-40's. was one of the most advanced in the world, especially in the field of fundamental developments. In this period in our country had been working such outstanding scientists as academician V.I. Vernadsky and V.N. Sukachev, as well as major environmentalists V.V. Stanchinsky, E.S. Bauer, G.G. Gouse, V.N. Beklemishev, A.N. Formozov, D.N. Kashkarov and others.

In the second half of the twentieth century due to theprogressive pollution of the environment and the sharp increase in human impact on nature, the ecologygains specialimportance.

As the**third stage** (the 50th of the 20th century - up to the present time) begins - the transformation of ecology into a comprehensive sciencetakes place, including the sciences about protection of the natural and human environment. From a strict biological science ecology turns into a "significant cycle of knowledge, incorporatingsections fromgeography, geology, chemistry, physics, sociology, culture and economics ..." (Reimers, 1994).

The modern period of ecology development in the world is connected with the names of such large foreign scientists as J.Odum, J.M. Harper, R. Whittaker, N. Borlaug, T. Miller, B. Nebel, and others. Among Russian

scientistsit is worth to name I.P. Gerasimov, A.M. Gilyarov, V.G. Gorshkov, Y.A. Israel, Y.N. Kurazkovskiy, K.S. Losev, N. N. Moiseev, N.P. Naumov, N.F. Reimers, V.V. Rozanov, Y.M. Svirizhev, V.E. Sokolov, V.D. Fedorov, S.S. Schwartz, A.V. Yablokov, A.L. Yanshin and others.

The first environmental protection acts in Russia are known from the IX - XII centuries (for example, the code of laws of Yaroslav the Wise "Russian Truth", where the rules for the protection of hunting and horde lands were established). In the XIV - XVII centuries atthe southern borders of the Russian state there were "zasechnyforests", a kind of protected areas, where commercial fallings were banned. The history has preserved more than 60 natural decrees of Peter I. With him, the study of the richest natural resources of Russia has began. In 1805the society of naturalists was founded in Moscow. In the late nineteenth and early twentieth centuries, the movement for the protection of rare objects of nature had arisen. The Scientific foundations of nature protection were laid by the works of such outstanding scientists as V.V. Dokuchaeva, K.M. Baer, G.A. Kozhevnikova, I.P. Borodina, D.N. Anuchina, S.V. Zavadsky.

The beginning of the nature protection activity of the Soviet state coincided with several first decrees, starting with the Decree on Land from October 26, 1917, which laid the foundations for nature management in the country.

During this periodspecifically, the *nature protection*has been born and receivedthe legislative expression.

At present, the dependence of the ecological state of various countries and regions of the planet on the development of the economy and the structure of production is vividly speaking. There is a rapid growth of the subsidiary area of ecology- the science of the human environment with its applied industries. Ecology appears in the center of acute human problems. This was confirmed in the 60's - early 70's bythe research of VA. Kovdy on the technogenic impact on land resources, elaborations of N.N. Moiseyev on the model of "nuclear winter", the works of M.I. Budyko about technogenic impacts on the climate and about global ecology. The attention of politicians of different countries is drawn to the economic,thanks to the works of the International Institute of Life and speeches of several prominent scientists, in particular, the outstanding oceanographer J.-I. Kusto, the economist-ecologist Maurice Strong, the Norwegian Prime Minister G.H. Brundtland, who headed the United Nations Commission on Environment and Development (ICRD).The report of this Commission "Our Common Future" (1987)had an exceptional importance.

Formation of ecological knowledge and culture

Ecologization meets the needs of society in combining science and practice to prevent ecological catastrophe. The appeal of various sciences to the problems of ecology and the human environment contains the formulation and solution of many practical problems. Ecology has evolved from a private section of biology, familiar to a narrow circle of specialists, into a vast and yet incompletely formed complex of fundamental and applied disciplines that NF Reimers (1992) called megaecology, i.e. "Large Ecology ". Now, the term macroecologyis used. (Figure 2)

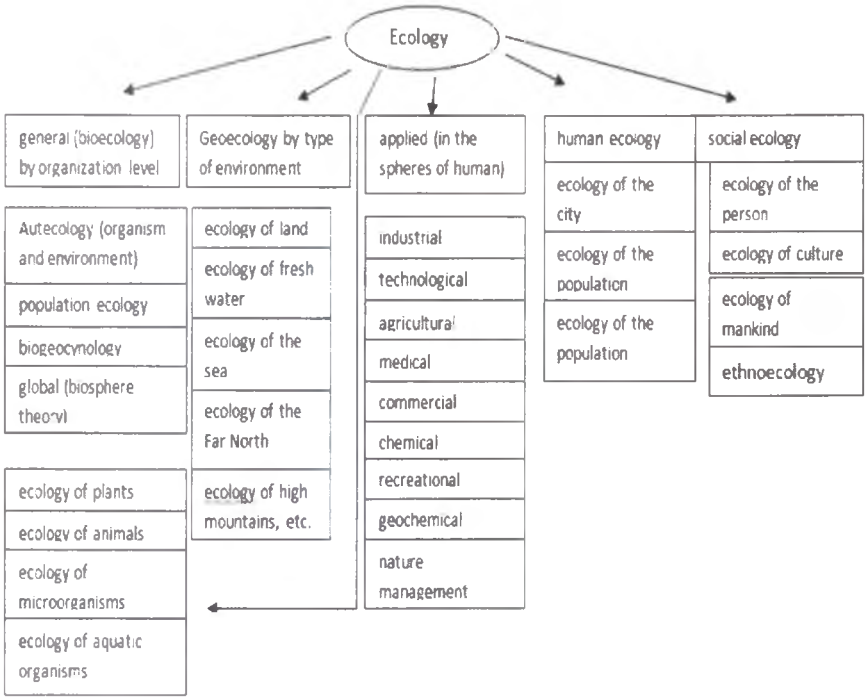


Figure 2- *Structure of modern ecology*

Nowadays, the spontaneous development of relationships with nature is a danger for the existence not only of individual objects, territories, countries, etc., but also for all mankind.

This is explained by the fact that a man is closely connected with the living nature by origin, material and spiritual needs, but, unlike other

organisms, these connections have reached such scales and forms that it can lead (and already leads!) to almost complete involvement of the animal cover of the planet (the biosphere) in the life-support of modern society, which put humanity on the verge of ecological catastrophe.

To stop the spontaneous development of events will only help the knowledge aboutits management and, in the case of ecology, this knowledge should "master the masses", at least for the most part of society, which is possible only through universal environmental education of people, starting from the school bench and finishing with university.

The ecological knowledge is necessary for every person, so that the dream of many generations of thinkers about the creation of a decent human environment would come true, for which it is necessary to build beautiful cities, to develop such perfect productive forces that could ensure harmony between man and nature. But this harmony is impossible if people are hostile to each other and, especially, if there are wars, which, unfortunately, taking place. As the American ecologist B.Commoner rightly noted in the early 1970s, *"searching the sources of any environmental problem leads to an undeniable truth that the fundamental cause of the crisis lies not in how people interact with each other ... and that, finally,the peace between people and nature must be preceded by the peace between people. "*

The development of human society is considered as part of the nature evolution, where the laws of ecological limits, irreversibility, and selection are operating. The emergence of the human environment problems is, in significant degree, anthropogenically indirect, i.e. caused by the person itself by violation of the regulatory functions of the biosphere. The latter cannot be restored or changed technically. The progress of mankind is limited by the ecological imperative - the requirement of subordination to the laws of nature. This is a **bio-centric**, or **eco-centric** approach, essentially placing the state and sustainability of living nature, the biosphere, at the center of environmental problems.

The choice between these two approaches or a compromise between them,in many ways, determines the strategy for the further development of human society. Most people are still inclined to the anthropocentric point of view because it looks simpler, more optimistic, and repulse from the previous practical experience of mankind. However, at present, there alreadyexist very strong arguments in favor of eco-centrism, which cannot be neglected.

But it would be unfair to build the entire ecology "around" only a human. And, actually, the ecology, as we have already shown above, arose to solve the

problems of studying the interaction of all living things with inanimate nature and organisms among themselves. Human is also the same organism, and its isolation from animals and plants of wild nature significantly affects its health. The pets and domesticplants can not completely replacea wildlife. The change, and even more, the destruction of this natural environment, entails deleterious consequences for human life.

The definition of the concept of "Sustainable development" and the role of ecology in the implementation of the concept of sustainable development

The concept of sustainable development was a logical transition from the ecologization of scientific knowledge and socio-economic development that had begun to flourish in the 1970s. To the issues of limited natural resources (NR), as well as pollution of natural environment, which is the basis of life, economic and any human activity, in the 1970s, a number of scientific works were devoted. The response to this concern was the creation of international non-governmental scientific organizations to study global processes on Earth, such as the International Federation of Institutes of Advanced Studies (IFIAS), the Club of Rome (with its famous report "Limits of Growth"), the International Institute for System Analysis, and in the USSR - All-Union Institute of System Studies.

We live in the 21st century, a new stage in the development of mankind. This requires us to be more accountable in our actions. The United Nations Conference on the Environment in Stockholm in 1972 drew the attention of all states to the problems facing the world community and defined a new path of development for the future - the concept of sustainable development. This concept came into use after the report of the International Commission on Environment and Development. It was given the following definition: "Sustainable development is the satisfaction of the needs of today's generation while preserving the possibility of covering the needs of future generations". This concept should allow countries to move away from current, often destructive, growth processes and begin moving towards sustainable growth. The main conditions can be distinguished as follows: priority of quality (life) over quantity (number, consumption); the preservation of biological and cultural diversity; the coordination of nature management with ecology. The second UN conference was held in June 1992 in Rio de Janeiro (Brazil), where five main documents were approved and adopted.

The holding of the United Nations Conference in 1972 on the Human Environment in Stockholm and the establishment of the United Nations

Environment Program (UNEP) have marked the inclusion of the international community at the state level in the environmental problems solution, that had become a deterrent to social and economic development. The environmental policy and diplomacy, the law of the environment began to develop, there has appeared a new institutional component - ministries and departments for the environment.

The theory and practice showed that the ecological component is an integral part of human development. The work of the International Commission on Environment and Development and its final report "Our Common Future" were based on the new three-pronged concept of sustainable (ecological, socio-economic) development. (Fig.3)

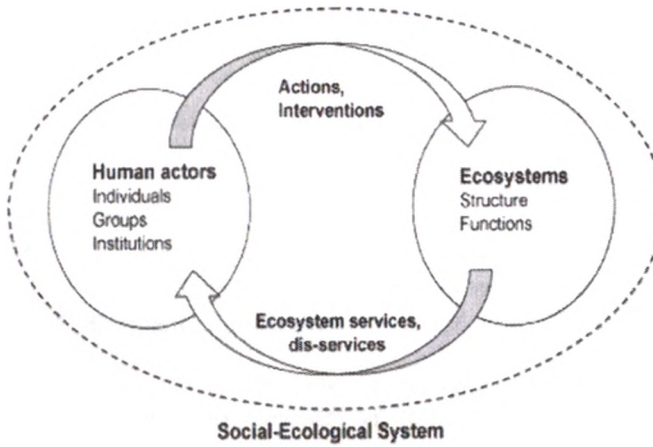


***Figure 3**- Sustainable development. Components*

The United Nations World Summit on Sustainable Development (intergovernmental, non-governmental and scientific forum) in 2002 reaffirmed the commitment of the entire world community to sustainable development ideas for the long-term satisfaction of basic human needs while preserving the life support systems of the planet Earth. The concept of sustainable development in many respects echoes the concept of the noosphere, that was put forward by academician V.I. Vernadsky in the middle of the 20th century.

Test tasks for self-control:

1. The term "ecology" was first proposedby

[a] [+] E. Haeckel

[b] C. Darwin

[c] N.Vavilon

[d] J.Libich

[e] V.Sukachev

2. How many keymilestones in the history of the development of ecology

[a] [+] 3

[b] 5

[c] 1

[d] 2

[e] 7

3. Ecology is

[a] [+] a science of the relationship of organisms or groups of organisms with the environment

[b] a theoretical basis for the rational use of natural resources

[c] an integrated science of a single system, cemented by multiple supply chains

[d]a study of the current state of the natural environment

[e] a study of anthropogenic impacts on the environment

4. What is the ecologization of technology

[A] [+] an improvement of the efficiency of natural resourcesusage and preserving the quality of the natural environment

[b] an introduction of new innovative technologies

[c] improving the quality of the natural environment

[d] a study of the current state of the natural environment

[e] a study of anthropogenic impacts on the environment

5. Which law treats that "in a complexof factors, the one that is closer to the limit of enduranceis stronger"

[a] [+] Liebig's law

[b] Bergman's law

[c] Gallo's law

[d] Gause's law

[e] Rubel's law

6. What is the sum of the influences of the ones organismsvital activity on the others

[a] [+] biotic factors
[b] abiotic factors
[c] inorganic factors
[d] organic factors
[e] Allelopathy

7. Which of these factors are related to the abiotic factors

[a] [−] temperature
[b] competition
[c] human activities
[d] parasitism
[e] depth of water canal

8. Which of the following factors apply to biotic factors

[a] [+] commensalism
[b] light
[c] radiation
[d] temperature
[e] humidity

THEME 2 THE AUTECOLOGY-THE ECOLOGY OF ORGANISMS

2.1 The Autecology-the ecology of animals
2.2 The environmental factors, their classification.
2.3 The patterns of activity of biotic and abiotic factors on the body.
2.4 The Law of minimumby Liebig and the Law of toleranceby Shelford

Autecology-the ecology ofan individual: organism and its habitat conditions

Autecology studies the relationships of organisms to the conditions of environment - is the oldest section of the General ecology. Essentially, autecologyby E. Haeckel was understood as ecology.The author of the theory of the organismsadaptation to the environment conditions through natural selection - C. Darwin -also was an autecologist.

This sectionof ecology includes characteristic of environmental factors (factor ecology) and ways of organism adjusting (adaptation) to various conditions. In the 20th century autecology has been updated with new sections about the functional role of organisms in the ecosystem and their life strategies.

Autecology explores the relationship of organisms withthe environment conditions on the levelof species, which is necessary as for population studies (this allows us to get behind "the brackets" those features, which are common to all populations of the same species), and for ecosystemsstudies, theelements of which are types of

Organism and Environment. The concept of environmental factor.

There are distinguished such concepts as the environment and conditions of organismsexistence.

Environment— is apart of nature,that surrounds theliving organisms and has a direct or indirect impacton them. Organisms are receivingfrom the environment everything that necessary for life and giving back products for exchange. The environment of every organism consists of many organic and inorganic elements of nature and as well of the elements generated by the man and his activities. Wherein, one type of elements may be partially or completely indifferentfor the organism, second may be necessary, while third may have a negative impact on it.

The living conditions or conditions for existence – are the sum of necessary elements of environment for an organism, with which it has an unbreakable unityand cannot exist without them.

The adjustments of organisms to the environment are called adaptations. The ability to adapt – is one of the fundamental characteristics of lifein general,that enables its existence, the possibility of organisms to survive and multiply. Adaptations are manifested atthe different levels – starting from the biochemistry of cells and behavior of individual organisms till the structure and functioning of the communities and ecological systems. All the adaptations of organisms to various conditions have been developed historically. As the result, there specific groups of plants and animals have been formed for each geographical area.

Environmental factors and its classification

The individual characteristics or elements of environment affecting the organisms are called *environmental factors* (table 1).

The diversity of environmental factors is subdivided into two large groups: abiotic and biotic.

Abiotic factors – a complex of conditions of inorganic environment that is affecting the organism.

Biotic factors – a collection of vital activity influences of one organism on another. In individual cases, the anthropogenic factors distinguish the independent group factors along with the abiotic and biotic, thereby, underlining the extraordinary effect of the anthropogenic factor. By agreeing with the above, we considerthat it is more appropriate to classify it as a part of the biotic factors of influence, since the concept of the "biotic factors" covers all the activity of the organic world, that the human belongs.

Table 1- **Different approaches to the classification of environmental factors**

ENVIRONMENTAL FACTORS	
ABIOTIC	**BIOTIC**
Light, temperature, humidity, wind, air pressure, flow, longitude of the day etc. Mechanical composition of soil, its	The influence of plants on the other members of biocenosis. Influence of animals on the other members of biocenosis

permeability, moisture-holding capacity Contentof the elements of nutrition in the soil or water, gas composition, salinity		Anthropogenic factors arising as a result of human activities
ON TIME	**ON THE PERIODICITY OF**	**ON THE ORDER**
Evolutionary Historical	Periodic Non-periodic	Primary Secondary
BY ORIGIN		**THE EMERGENCE OF ENVIRONMENT**
Space Abiotic (abiogennyj) Nutrient Biotic Biological Natural and anthropogenic Anthropogenic (including technogenic, environment pollution, including anxiety		Atmospheric Water (moisture) Geomorphological JEdaphic Physiological Genetic Population Biocenotic The ecosystem Biosphere

The combination ofone kind of factors iscomposing the top level concepts. The bottom level concepts isassociated with the knowledge of individual environmental factors.

Anthropogenic factors– factors, generated by human and affecting the environment (pollution, soil erosion, deforestation, etc.) are considered in applied ecology.

The factors, which change over time is repeated regularly, are called **periodic**. These include not only climatic, but also some hydrographic-high and low tides, some ocean flows. The factors that occur suddenly (a volcanic eruption, the predator attack, etc.) are called non-periodic. The organisms are adapted to the permanent periodic factors, but it is important to distinguish it between **primary** and **secondary**.

Primary factors are those that existed on Earth even before the beginning of life: temperature, illumination, high and low tides, etc. The adaptation of organisms to these factors is the most ancient and perfect.

Secondaryperiodic factors are the consequence of changes in primary: humidity, that is temperature-dependent; vegetable food, that depends on cyclicity in development of plants; several biotic intraspecific influence factors,

etc. It had emerged laterthan primaryfactors and the adaptation to it is not always clearly expressed.

Environmental factors may have a different effect: limiting, irritating, modifying, signal. **Limiting** -makes it impossible to exist in these conditions. **Irritable**– a source adaptations. **Modifying** -causes morphological and anatomical changes. **Signal** -informs about the changesin the environment. All the factors in the nature are operating in an integrated manner, this is called as living conditions. The conditions where no breeding occurs are called the **conditions of existence.**

The environment factors influence isprimarily determined by its effects on the metabolism of organisms. Hence, all the environmental factors can be divided by its activity into direct and indirect. Both factors may have a significant impactas on the individual organisms' lifeso as on the entire community. The environmental factors mayappear eitherin direct or in indirectform. Each environmental factor is characterized by certain quantitative indicators, such as the power and range of action.

The conditions, whereddifferent plants and animals feel especially well are not the same. For example, some plants prefer very moist soil, the other prefer relatively dry. Some require intense heat, otherscan tolerate colderenvironment better, etc.

The intensity of ecological factor - the most favorable for theorganism's life – iscalled optimum, and the one giving the worst effect — pessimum, i. e. the conditions under which the organism's vitality is maximally oppressed, but it could still exist. So, while growing plants at various temperatures,the point where we oversee the maximum growth will be our *optimum.* In most cases, this is some kind a range of temperatures of several degrees, so here, it is better to talk about the *optimum zone.* the entire range of temperatures, from the minimum to the maximum, where the growth is still possible, is called a *range of sustainability* (endurance) or tolerance. The points of restricting it, i. e. the maximum and minimumsuitable temperaturefor life —are the *limits of sustainability.* Between the optimumpoint and the limits of sustainability, as we approach the lastone the plant is experiencing an increasing stress, i.e. talking about stress zones or zones of oppression within the range of sustainability (fig. 4). From optimum down and up the scale, not only stress is increasing, but when, finally, after reaching the limits of organism's resistance is followed by its death.

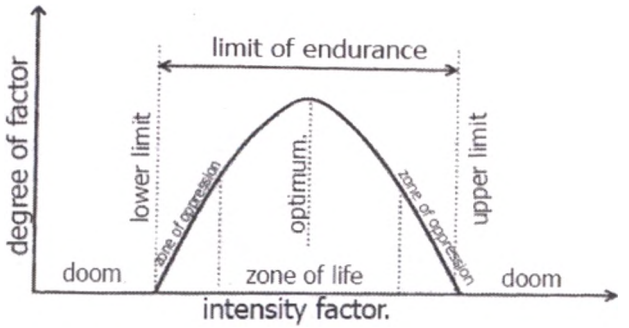


Figure. 4. *The dependence of actions environmental factofrom its intensity*

Such experiments can be hold and to test the influence of other factors. The results graphically will fit the curve of a similar type.

The repeatability of the observed trends makes it possible to draw the conclusion that here we are talking about fundamental biological principle. *For each type of plant (animal) there is an optimum, stress zones and limits of sustainability or endurance regarding each factor.*

With the factorvalue, close to the limits of endurance or tolerance, the organism can usually exist only for a shortperiod of time. In a narrower range of conditions the existence and growth of individuals may be prolonged. In even more narrower range, there reproduction occurs, and theclass can exist for indefinite time. Usually, somewhere in the middle of the range of sustainability there are conditions, which the most favorable for life, growth, and reproduction. These conditions are called optimal, where individuals of this species come out to be the most adapted, i.e. leave the highest number of descendants. In practice these conditions are difficult to detect, and usuallythere is an optimum determined for individual signsof livelihood — growth rate, survival, etc.

The quality of species to adapt to a range of environmental factorsis indicated by the concept of "ecological plasticity" (ecological valence)of species. The wider the range of fluctuations of ecological factor, within which this type may exist, the greater its ecological plasticity.

Species, that can exist with somesmall deviations from a factor, from the optimum value, are called highly specialized, andthe ones that can withstand some significant changes of the factor - are widely adapted. For example, to thehighly-specialized species arerelated freshwater organisms, which normal

life is retained with a low salt content in the environment. On contrary, forthe mostsea inhabitants, the normal vital activity is persisted at a high concentration of salts in the environment. Hence, the freshwater and marine species have a low ecological plasticity in relation to salinity. At the same time,the three-prickle stickleback,for instance,is characterized with a high ecological plasticity since it can live in both fresh and salt water.

Environmentally strong species are known as *eurybiotic* (eyros – wide): weak species – *stenobiotic* (stenos is narrow). Theeurybionticity and stenobiontenessare characterizing different types of organisms' adaptations for surviving. The types, which are developing for a long time in a relatively stable environment, are losing the ecological plasticity and elaborating the features of stenobionteness, whereas, the species, which were existing duringthe significantly fluctuated factors of environment, getting an increased ecological plasticity and becoming to be an eurybiotic(fig. 5).

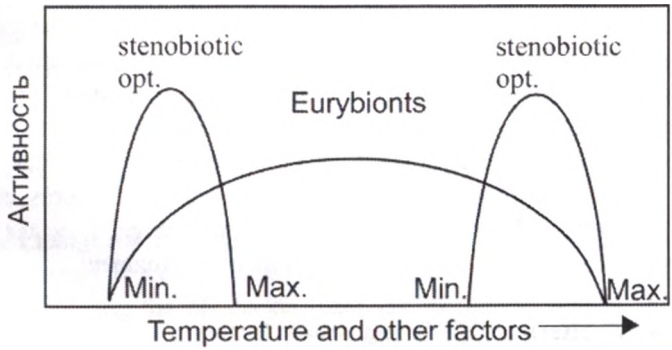


Figure. 5 *The Ecological plasticity of the species (y. Odumu, 1975)*

The relevance of organisms to variations of a certain factor is expressed by adding the prefix "Eury-or Steno-" to the name. For example, in relation to the temperature, there are distinguished eury and stenothermicorganisms, to the salt concentration areeury and stenogalic, to the light – eury and stenophotic, etc. In relation to all factors of the environment, the eurybiotic organisms are rare. More often, euryor stenobiontnessappears in relation to the individual factor. So, the freshwater and marine fish are stenogalic, whereas, previously named,three-prickle stickleback is a typical eurygalic representative. The plant, while beingeurythermic, at the same time can be referred to stenohygrobionts, i.e. be less persistentregarding the fluctuations of humidity.

Generally, the eurybionticityis facilitating the wide spread of species. Many of protozoas, fungi (typical eurybionts) are cosmopolites andare distributed everywhere. Stenobiontness is usually limiting the habitat. At the same time, it is not rare that wide territories belong to stenobionts due to their high specialization.For example, fish-eating bird Osprey (Pandion haliaetus) is a typical stenophagus, but in relation to other factors it is eurybiont, it can move over long distances while searching for food and occupies quite significant area.

All these factors are interrelated, and there not even one that is fully indifferent to any organism. In general, population and species react to these factors, perceiving it differently. Such selectivity conduces the selective attitude of organisms to the occupation of the given territory.

Different species have different requirements to soil conditions, temperature, humidity, light, etc. So, there are different types of plants growing on different types of soils in different climate zones. On the other hand, in different plant associations are formed different conditions for animals. While adapting tothe abiotic factors of environment and engaging in a certain biotic connection with each other, plants, animals and micro-organisms are distributed on the variousenvironments and forming diverse ecosystems,uniting into biosphereof the Earth. Therefore, the organisms and the populations formed from them are adapting to each factor of the environment in a quite unknown way. Its ecological valence in relation to different factors turns out to be unequal. Every type has a specific environmental range, i. e. the sum of environmental valences in relation to the factors of environment.

Activity patterns of biotic and abiotic factors

In the complex of factors' activity, it is possible to identify some patterns, which are largely generic (common) in relation to the organisms. To such patterns is*related the law of optimum, the law of factor's interaction, the law of limiting factors* and others.

The law of optimum.

According to this law, there is a range of the most favorable (optimum) factor value for the ecosystem, organism or a particular stage of its development. Out of optimum limits there are oppressionzones, transitioning to critical points, beyond which the existence is impossible. The maximum density of population is usually timed to the optimum zone.

Thelaw of factors' interaction.

The essenceof this law lies in the fact that *some factors increase or decrease the power of the other factors*. For example, the excessofheat may, in some extent, be mitigated by a lower humidity, the lack of light for photosynthesis of plants is compensated by a higher content of carbon dioxide in the air, etc. This, however, does not mean that factors may be interchange. They are not interchangeable.

The law of limiting or restricting factors.

The essence of this law is that *thefactor, which is in lack or in surplus(close to the critical points)) has a negative impact on organisms and, furthermore, limits the ability of other factors to demonstrate its power on the other factor, including the ones in optimum.*For example, if the soil is in sufficiency with all the chemical elements, required for a plant,but one, the growth andthe development of plants would be conditioned by the one in lack. All the other elements would not demonstrate their influence. Limiting factors usually determine the boundaries of species (populations)distribution,its habitats. The productivity of the organisms and communitiesdepends on it. Therefore, it is essential to identify on time the factors of excessand minimum values, andexclude the possibility of its manifestation.

The LiebigLaw of Minimumand The Shelford's law of Tolerance

The concept of limiting factors was introduced in 1840 g. by a chemist J. Liebig. By studying the effects on plant growth of the content of different chemical elements in the soil, he formulated the principle: "The substance in minimum is managing the harvest and determines its magnitude and sustainability in time." This principle is known as *the minimum Liebiglaw or rule*. As an illustration of the Liebig minimum law it is often depicted a barrel, where the boards that creatingthe lateral surfaceare having different heights. (fig. 6).

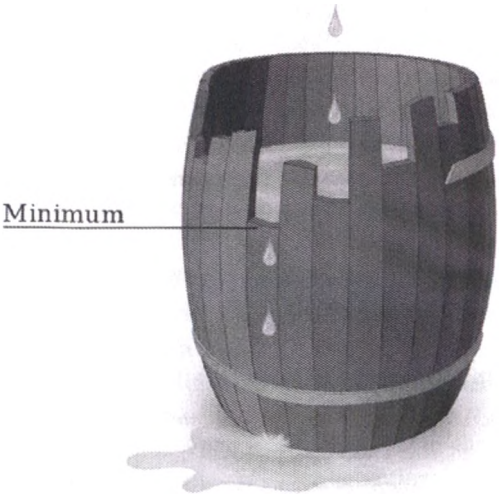


Figure. 6. *"Barrel Liebig»*

The length of the shortest board determines the extent to which it is possible to fill the barrel with water. Therefore, the length of this Board is a limiting factor forvolume of water that can be poured into the barrel. The length of the other boards has no value.

Let's explain the Liebiglaw of minimum on concrete examples. The soil contains all the elements of mineral nutrition which necessary for this type of plant, but one of them, such as boron or zinc is missing. The growthof plants on this soil will be severely depressed or even impossible. Now, if we add to the soil the right amount of boron (zinc), this will increase the harvest. But if we're going to make any other chemical compounds (e.g., nitrogen, phosphorus, potassium) and will ensure that they will all be in optimal quantities, and boron (zinc) will be absent, it will not give any effect. Same way, if acidity(pH) of the soil deviates from the optimum, let's say for winter rye, then none of the agro-technical measures, besides decreasing the limestone acidity, are not going to help to significantly increase the productivity of this culture on this field. TheLiebig minimum law applies to allabiotic and bioticfactors, that affect the organism.For example, this can be competition with other species, the presence of a predator and parasite. The formulated law applies to both - plants and animals.

As a limiting factor could be not only drawback, Liebig highlighted that point, but an excess of such factors as heat, light and water. As noted earlier, organisms are characterized by ecological minimum and maximum. The ranges between these two values is usually called the limit of sustainability, endurance or tolerance. An idea of limiting impact on maximum same as on minimum was introduced by Shelford (1913) who had formed the law of tolerance. After 1910there had been conducted a numerous amount of researches on "ecology of tolerance",thanks to which the limits of existence for many plants and animalsbecame known. As an example, according to G.V. Stadnickiy, A.I.Rodionov (1966) the existence of the impact from air polluting substances on the human body (fig. 7).

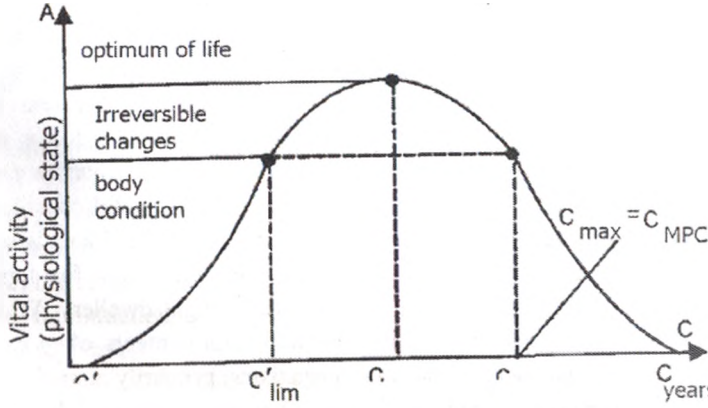


Figure. *7 The impact of the air polluting substances on the human body*

The line of the factoris marked witha symbolC (the first letter of the Latin word "concentration"). In other cases, when the flow of substancesentering the body, we can talk not about the concentration, but about the dose of a substance (factor). With the value of concentrations C_{years} and C'_{years} the human being will die, butwith significantly lower valuesthere will be irreversible changes in the human body: C_{lim} and C'_{lim}. Therefore, the true range of tolerance is defined exactly by the last values. Hence, these values should be experimentally, experiencing on animals, determined for each pollutant or any harmful chemical compounds and in order to avoid overstepping its content in particular environment. In the sanitary protection of environment,the importance lies not in the lower limits of resistance to harmful substances, but in *the upper*

*limits*since the environmental pollution - is the excess of the organism resistance. There appears a goal or condition: the factual concentration of pollutant C_{fact} shall not exceed C_{lim}or:

$$C_{fact} \leq C_{lim}$$

Thus, C_{lim} is the threshold concentration C_{thr} and at the same time the maximum admissibility C_{max} for the human body. In the sanitary environment protection C_{lim}has the meaning of maximum permissible concentration — C_{mpc} (or MPC).

The value of concept of limiting factors is that it givesthe ecologist a starting point in the study of complex situations. By examining specific situation, an ecologist can highlight the weakspots and focus on those environment conditions, which are likely to be disruptive or limiting. If the organism is characterized by a wide range of endurance (resistance, tolerance) tothe factor, that differs by a relative constancy, and is present in the environment in moderate amounts, it is unlikely that such a factor can be limiting. On the contrary, if it is known that an organism has a narrow range of tolerance to a volatile factor, then this factor deserves a careful consideration, since it can be limiting. So, the oxygen content in terrestrial habitats is so great and so available that can rarely serve as a limiting factor for terrestrial organisms, except for parasites, the soil or great heightsdwellers. While the amount of oxygen is relatively smallin the water, its contents often can vary greatly, and as consequence for the water organisms, primarily animals, it often serves as an important limiting factor. Therefore, aneco-hydro-biologist alwaysgot to prepare a device for determining the amount of oxygen and measures the content of this gas in the course of studying any unfamiliar situation. The same environmentalist, that studies terrestrial ecosystems, rarely has to measure the oxygen content. In general, the meaning of the environment conditions analysis, for example, while evaluating the human impact on the naturalenvironment, is as follows:

- by observing, analysis and experiment to discover the "functionally important" factors;
- to determine how these factors affect individuals, populations, communities, then it is possible topredict quite accurately the outcome of environment violations or its planned changes.

Test tasks for self-control:

1 environmental factors are the conditionsof

[a] environment

[a] hydrosphere

[a] atmosphere

[a] lithosphere

[a] biosphere

2 what is the sum of the influences of the vital activity of one organisms onanother

[a] [+] biotic factors

[a] abiotic factors

[a] inorganic factors

[a] organic factors

[a] Allelopathy

3 the limit of species endurance with respect to the environmental factor is called

[a] [+] tolerance

[a]aspect

[a] life form

[a] reproduction

[a] adaptation

4 In certain regions of ecological factor there are conditions, that created for afavorable development of organisms. What is the name of the zone

[a] [+] optimum

[a] stability

[a] pessimum

[a] maximum

[a] minimum

5 Whatisthe range between minimum and maximum environmental factor

[a][+] the limit of organisms' tolerance

[a] the index of limiting factor

[a] the limit of limiting factor activity

[a] the index of minimum factor activity

[a] the index of organism's sustainability

6 the limit of endurance is

[a][+] conditions, when normal vital activity of the organism is not possible

[a] the most favorable conditions for the life of the organism

[a] conditions for normal life of the organism

[a] optimal conditions for the life of the organism

[a] deviationof the factor from optimum values

7 Species,that are resistant to only small deviations from optimum factor values are called

[a][+] stenbiotic

[a] eurybiotic

[a] eurygalic

[a] stenothermic

[a] eurythermic

8 Which activity scope of ecological factor is called "optimum zone"

[a] [+] comfort zone

[a] oppression zone

[a] death zone

[a] endurance zone

[a] maximum zone

9 what are species that can exist in a wide range conditionsof ecological factor

[a] [+] tolerants

[a] stenobionts

[a] adaptants

[a] resistants

[a] eurybionts

10 What is the name of the factor, the level of which, in relation to quality or quantity quantitatively turns out to be close to the limits of endurance

[a][+] limiting

[a] minimum

[a] maximum

[a] lethal

[a] sub-lethal

3.1. Demecology-the ecology of populations: it's static and dynamiccharacteristics

3.2. Ecological structure of population. Regulation mechanisms of population size

3.3. Survival strategies. Population growth curves

Demecology- the ecology of populations: static and dynamic features

In the nature, every existing type of species representsa sophisticated complex or evena system of intraspecific groups, whichinclude the individuals with specific features of structure, physiology, and behavior. Such an intra-specific merger of species iscalled **population**. The term "population" was first introduced by Danish scientist Iogansenin 1903 for designation of "the natural mixture of individuals of the same species, which are genetically heterogeneous. Later, this term has acquired ecological importance and denoted the population of species, that are occupying a particular territory. By S. Schwartz (1980) definition, **population** is a basic grouping of organisms of a certain type, having all the necessary conditions to maintain itsquantityfor a long time in a constantly changing environment conditions.

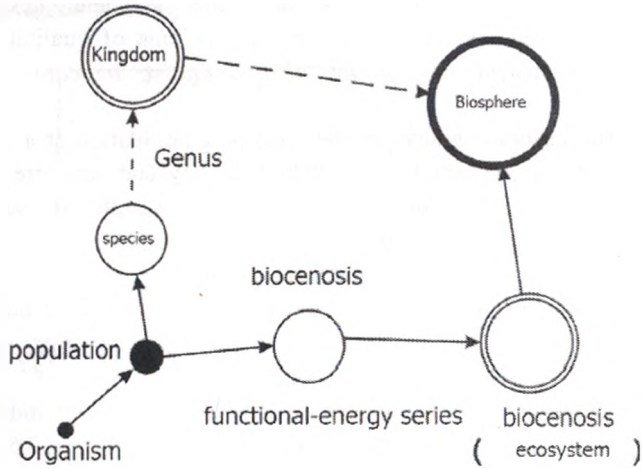


Figure. 8. *the position of the population in the structure of the biological systems of the biosphere (I.A. Shilov)*

As you can see on the Figure.8., the population takes an ambivalent place in the system of biological structures. In genetic-evolutionary series it protrudes as a form of the species existence, which's main objective is providing a sustainable survival and species reproduction under given conditions. In the energy-functional series it performs as a functional subsystem of a specific biogenesis, it's functionis to participate in a trophic binding. The fulfillment of these functions ensures the participation of the species in the biogenic cycle.

Nowadays, the term "population" is used, in a narrow sense, when talking about the specific intraspecific group, that isinhabiting a certain biogeocenosis, and in broad general sense, to identify separate groups of species regardless ofthe inhabiting territory and genetic informationit carries.

The population is a genetic unitof species, which changes are proceeded by the species' evolution. As a group of individuals of one speciesliving together, the population being performed as the firstsuperorganic biologicalmacrosystem. Population, as a biological unit, has a specific structure and function. The population structure is characterized by its constituent species and their distribution in space. The functions of population are similar tothe functions of other biological systems. It is characterized by growth, development, the ability to maintain existence in the constantly changing environment.

Static and dynamic characteristics

It is known that the most important characteristics are the quantitativeones, which allow to solve most problems of qualitative nature. There are distinguished *two groups of quantitative indicators*-static and dynamic.

Static indicators characterize the state of a population at a given time. The statistics indicators include the number, density and structure indicators. Depending on the size of the habitat's populations the quantity of individuals in populationsmay change significantly.

*The populationquantity*is the total number of individuals in a given area or amount. It depends on the ratio of reproduction (fecundity) intensity and mortality. The growth of population comes with the breeding season. On opposite, mortality, leads to the quantity decrease.

The population density is determined by the number of individuals or biomass per unit area or volume, for example, 400 trees on 1 ha, 0.5 g Cyclops in the 1 cubic meter of water. Often, it is important to distinguish between the average density, i.e. a number or biomass per unit of total space, and specific or ecological density – a number or biomass per unit of inhabited space, available

space or volume, which, practically, might be occupied by population. Population density differs byvariability and bydependence on its quantity. During the quantity increase, the densityincreaseis not marked only in case of possible population distribution,its range expansion. Individuals,that are components of population have different types of spatial distribution, expressing their reaction to various influences, for example, prey and favorable physical conditions or competitive reactions. There are distinguished three types of distributionor resettlement of individuals within the population: even, random, or group. (Fig. 9)

Even distribution can be met in nature quite rare. Itoften involves wild competition between different individuals. This type of allocation is marked with predatory fishes and sticklebackswith its territorial instinct and highly individual character.

Random distribution takes place only inthe homogeneous environment. So, at first, there are aphids distributedon the field. And as it is breeding, the distribution acquires group or spotted (congruous) character.

Group distribution occurs the most, whereinit may bealso random. So, in a pine forest, the trees initially distributed by groups, but further it becomeseven. A group distribution providesfor population greater stability in relation to adverse conditions compared to a separate individual. Animals with active lifestyle, usually distributing actively which leads to intensive mixing of populations and a blurring of the lines between them.

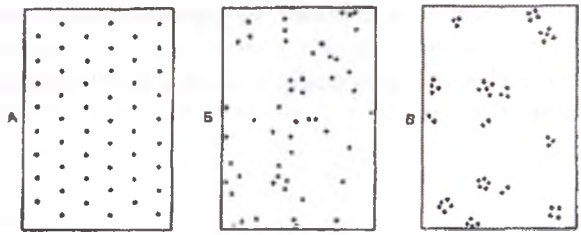


Figure. 9. *types of individual's distribution in thepopulation: a)even, b) random, c) group*

On contrary, the passively moving and sedentary organisms, have its populations clearly delineated even in a relatively small territory. These are populations of terrestrial mollusks and many amphibians. The size of the population range depends on the magnitude ofits species. Small individuals

occupy relatively small areas, whereas species with large individuals are extensive. However, this rule has many exceptions. So, the area occupied by the population of quick lizards, can vary from 0.1 up to several hectares.

The value of type of organisms'distributionhas a great importance when evaluating the population density by the sampling method (in case of group distribution the sample area should be greater). Let's take"n" number of samples. The average number of individuals in each sample, indicating through "m", we obtain the scattering or variance S^2 get according to the formula:

$$S^2 = (x-m)^2/n-1$$

During *even distribution* of variance S^2 is equal to zero, since the number of individuals in each sample is constant and equal to the mean. In case of *random distribution* - a mean "m" and variance S^2 are equal. In the *group distribution,* the scattering S^2 is above average, and the more the difference between it the stronger tendency animals have for formation of the clusters.

Each animal complies with the energy balance they spend on protecting the territory, collecting food and receiving it by eating food. When supply of food is decreasing, then animals extend their territory (while man, for example, "raises a devotee"). This type of animal's behavior is called **territorial behavior**. The bigger the animal, the greater is the area for its food extraction, so the larger the individual's body size, the smaller the density of population.

The territorial boundaries can be very flexible. The borders of non-migrating animals (rodents, shellfish)can be determined quite accurately, they create so-called local populations. If talk about active populations – here it is hard to determine clear boundaries, for example, such as moose, and even harder with birds that are easy to migrate and colonize large areas. The possibility for resettlement is limited as by biotic so as abiotic factors. As biotic factors of environment we can name, primarily,such as press predators and competitors, the lack of food resources, while the impact of abioticfactors is determined by the tolerance of the populationto the factorsof environment.

The press of predators is especially strong when in the co-evolution of predator-victim, the balance is shifted toward the predator and the victim'sarea is diminishing. The competition is closely linked to the lack of food resources, it can also be a direct fight, for example, predators fight for space as afood resource, but mostly it is simply the eviction of the species, for which the amount of food on specific territory is notenough by the species, for which the same quantity of food is enough. This is already the **interspecific competition.**

The indicatorsof structure are: sex-sex ratio, size–a numberratio of individuals of different sizes, age – ratio of number of individuals of different age groups in the population. The description of the sex and age composition of the populations are called as demographics ("demos" people, "grapho"-write, describe).

Anytype of individuals, when aging, naturally change the nature of their relationship with environment and resistance to individual factors. Some species have their age differences expressed very dramatically, they may even change the environment that they occupy, the nature of nutrition, ways ofmoving around. The larvae of dragonfly-beam - are typical water residents with reactive type of water movement, and adult representatives have an air-ground typewithwaving flight. Butterflies,after metamorphosis are changing the gnawing type of nutrition to the sucking type, and from crawling to the flight, etc. All types of individuals during the course development have their more vulnerable stages and more sustainable. It is known, that sprouts plants, animal calves are more sensitive to adverse conditions than adult developed organisms. Also, males and females may vary according to environmental conditions. For example, males of blood-sucking mosquitoes do not need the blood of vertebrate animals, they suck nectar from flowers.

The age structure of the population, i.e. the ratio of different age groups in it, depends on two factors: the characteristics of the species life cycle and from the external conditions.

There are species with a very simple age structure of populations, who consist of almost the same agegroup. For example, all the annualsplants during springtime are as sprouts, then it booms almost at the same time, give the seeds by the fall and die. Among animals, there are also species with similar age populations, for example, many species of locust are presented as larvae in the spring, in early summer – as wingless immature individuals, then as winged forms, and in late fall – only as eggs, hidden in soil in the egg-caps.The representatives of different generations of this type of individuals never meet each other. Its number is very variable depending on the external environment. If during the vulnerable period of development comes frost or drought,then mass death occurs. In a favorable situation, the population can give a quantity explosion. For species with a simpleage structure, the change of population density in hundreds and thousandstimes is a normal ecological phenomenon.

The complex age structure of populations occurs whenthere are all age groupsrepresented, at the same time, few generationslive together, when adult individuals reproduce repeatedly, and have a long life. In the herd of elephants

or monkeys-baboons, for example, there are newborns and teenagers, and young growing animals, and breeding females and males, and older individuals. Such populations are not subject to large fluctuations in population size. Critical external conditions can change their age structureby the death of the weakest, but the most stable age groups survive, and then restore the structure of the population.

Human being as abiologicaltype of species has a complex structure of populations. The ratio of age groups in populations canbe clearly expressed through the pyramid of ages. The nature of this pyramid can predict the nearest fate of a specific population. If it has a wide base, i.e., a lot of young individuals, and a narrow peak - a little number of old representatives, and the middle part is fairly presented, i.e. multiplying adult individuals, the overall configuration of such pyramid describes a growing population. If the basis is narrowed and peak is expanded, then in the nearestfuture the increase of such population should not beexpected, its mortality exceeds the birth rate.Obviously, each type of species has its own configuration of the age pyramid if the quantity is sustainable, so it's necessary to know well the character its development and relationship with environment.

The dynamic indicators characterize processes, that occurring in the population for someperiod of time (interval). The main dynamic indicators (characteristics) ofpopulations are fertility, mortality and growth rates of populations.

Dynamics of population number and density of populations is closely dependent on fertility or fecundity and mortality.

Fertility or fecundity is the ability of a population to increasethe quantity. It characterizes the frequency of new individuals in the population. The fertility can be distinguished between absolute and specific. *Absolute (total) fertility*-the number of new individuals (Δ Nn) added per unit of time (Δ t). *Specific fertility* is reflected in the number of individuals per species per unit of time. Fertility or fertility rateis expressed by formula:

$$P(A)= \Delta Nn/\Delta t,$$

where ΔNn is the number of individuals (eggs, seeds, etc.) born (pending, produced, etc.) for a certain timeframe Δt.Although,to compare birth rates in different populations, the value of specific fertilityis used: the fertility rate to the original velocity ratio (N):

$$RU= \Delta Nn/N\Delta t.$$

In living organisms laid a huge opportunity for reproduction and it is confirmed by the rule of maximum fertility (reproduction): in the population, there is a tendency to the formation of the theoretically maximum possible number of new individuals. It is achieved in ideal conditions when there is no limiting environmental factors andthe reproduction is only limited by physiological characteristics of the species. For example, one dandelioncan sow in less than 10 years sow the globeby only its descendants, if all the seeds sprout. Another example: bacteria divides every 20 minutes. At that rate, one cell in 36 hours can breedand cover anentire layer of our planet. Usually, there is an ecological or realized fertility that occurs in normal or specific environment conditions. The average fecundity rate had been chosen historically as a device which provides replenishment of populations' loss. Of course, species, that are less adapted to adverse conditions, having a high mortalityrate in young (larval) age and it is compensatedby significantly high fertility.

The herbivorous forms have the highest fecundity among the insects, and the lowfecundity have predators and parasites. In favorable conditions, fertility is usually low. The nature of the fertility depends on the speed of puberty, the number of generations during the season, the ratio of females and males in the population. If the type of breeds with great speed and responsive to changing environment conditions, then the number of populations is changingsignificantly and fast. This applies to many insects andmice. Thus, the maximum fertility or fecundity is a constant, that is defined by calculated path, for example, by multiplying the average number of nests, which the female birdscan build per year, on the same number of eggs, thatit can layat the most favorable part of the season.

Maximum fertility is a limit, that is typical for speed increase in the number of individuals in a population. The law of maximum fertility (reproduction) is a special case of the law of maximum biogenic energy (Entropy) V.I. Vernadsky-E. Bauer. The fertility may be zero, or positive, but never negative. Regarding the growth rate of the population, here ΔN -is pureincrease or decrease in population, which is not only the result of fertility, but also deaths, evictions, settling, etc., The population growth ratespeed may be zero, negative, or positive because the population may decrease, remain unchanged or increase.

The size and density of the population depends on its mortality. **Population mortality is** the number of animals killed for a certain period. **Absolute (total) mortality**is the number of individuals killed per time unit

(ΔNm). **Specific mortality** (d) is expressed by the attitude of absolute mortality to the population size:

$$\mathbf{d = \Delta Nm/\Delta tN;}$$

Absolute and specific mortality characterize the speed of population decrease due to death of individualsfrom predators, disease, old age, etc. But the decrease or increase of organisms in populations depends not only on birth and death rates, but also on the speed of their immigration and emigration, i.e. the number of individuals arriving and departing in and out of population per unit of time. The increase in the number depends on the number of born individuals(born for some period of time) and the immigratedindividuals, and the decrease in the number depends on death (mortality in a broad sense) and the emigration of individuals.

The duration of species' life depends on conditions (factors) of life. There are distinguished physiological and maximum duration of life.

Physiological duration of lifeis duration of life, which is defined only by the physiological possibilities of the organism. Theoretically, it is possible,if assuming that during the entire life of the organism, it was not influenced by limiting factors.

Maximum duration of life is the duration of life, to which extend can survive only a small proportion of individuals in the wild environment. The amount of time may vary widely: from a few minutesin case of bacteria up to several thousands of years in case of woody plants (Sequoia), i.e. from 103 to 1011 s. Usually, the larger the plant or animal, the longer its life expectancy, although there are exceptions (bats live up to 30 years, longer life, for example, than a bearhas).

Mortality and fertility of organisms is changing substantially with the age structure of the population, it is possible to display the mechanisms of total mortality and determine the structure of the life expectancy. Such information can be obtained by using the tables of survival. *Table of survival*, or so called "demographic tables" contain information about the nature of death distribution based on age. Demography studies the placement, size, composition and population dynamics, and it uses tables to determine the life expectancy of ahuman. Survival tables can be dynamic and statistical.

Dynamic tables are constructed according to the direct observation of cohorts' life, i.e., a large group of individuals, born in population within a short

period of time regarding to the overall life expectancy of studied species, registration of all member'sdeath age of this cohort. Such tables require prolonged observation, measured (for different animals) for months or years. But it is almost impossible to make such a table for long-living animals and humans-this may require more than 100 years. So, there are other tables being used for that -statistical.

Statistical tables of survival are observed over a relatively short period of time for mortality in certain age groups. If we know the number of these groups (coexisting cohorts) thenwe can calculatemortality, specific for each age (table 2, New, 1990)

Table 2- **The statistical population female population table Canada, 1980 (Krebs, 1985)**

Age Group	Number of individuals in each age group	Number of death cases in each age group	Mortality per 1000 individuals
0 – 1	173400	1651	9,52
1 – 4	685900	340	0,50
5 – 9	876600	218	0,25
10 – 14	980300	234	0,24
15 – 19	1164100	568	0,49
20 – 24	1136100	619	0,54
25 – 29	1029300	578	0,56
30 – 34	933000	662	0,71
35 – 39	739200	818	1,11
40 – 44	627000	1039	1,66
45 – 49	622400	1664	2,67
50 – 54	615100	2574	4,18
55 – 59	596000	3878	6,51
60 – 64	481200	4853	10,09
65 – 69	413400	6803	16,07
70 – 74	325600	8421	25,86
75 – 79	235100	10029	42,66
80 – 84	149300	10824	72,50
85 and older	199200	18085	151,70

These tables represent, so called, time section through the population. Ifthere are no significant changes in mortality and fertility ratesof population, then statistical and dynamic tables match.

Population growth curves

These tables of survival allow to build a survival curves reflected in dependency of number of individuals survived until a certain age from the length of the interval starting from the moment of appearance of organisms.

There are three types of basic survival curves to which, one way or another, can be approachedall of the known curves. (Fig. 10)

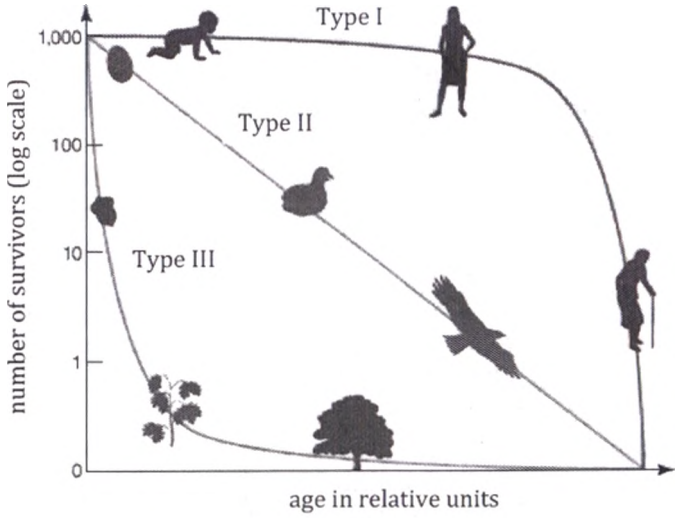


***Figure 10**- Various types of survival curve*

The curves of 1st type, when the mortality throughout life is negligible small, and sharply increasing at the end of it, characterized the insects that usually die after laying eggs (it is called the "Drosophila curve"), the curves of human survival in developed countries are approaching to it, as well as some of the larger mammals.

The curveof 3rd type – are cases of mass deaths of individuals in the initial period of life. Aquatic and some other organisms - do not care about posterity, they survive due to the huge number of larvae, eggs, seeds, etc.

Clams, before gaining a foothold at the bottom, passing the larvae stage as a plankton, where larvae are dying in huge numbers, so the curve 3is also called "Oyster's curve".

The curve of 2nd type (diagonal) characteristic for the species, which mortality rate remains approximatcly constant throughout life. This distribution of mortality is not such rare phenomenon of organisms. It occurs among fish, reptiles, birds, and perennial herbaceous plants.

The actual survival curves are often represented as some combination of the Theoretically, any population can have a limited increase in the number, if it is not limited by external environment factors. In such a hypothetical case, the population growth rate will depend on the magnitude of biotic potential characteristic to that species. The concept of biotic capacitywas introduced to ecology in 1928 by R. Chapman. This indicator reflects the theoretical maximum for the descendants from one couple (or oneindividual) per unit of time, for example, for the year or for the entire life-cycle.

During calculations, it often expressed as r factor and calculated as the maximum possible growth of population ΔN per period Δt, referred to one individual with initial population size N0:

$$\Delta N/\Delta t = rN0;$$

$$r = \Delta N/\Delta tN0$$

However, the growth of populations of any species in the nature is never infinite. Soon or later, the population will face restrictions,whichwill not allowfurtherincrease of its abundance. The resources, due to which the speciesexist (food, shelter, suitable places for breeding, etc.), on any territory have limits. These limits are being calledas capacity of environmentfor specific populations...

Types of population size dynamics

The size of any population is extremely dynamic, i.e. subject to constant changes. The population growth curve, indicating that it eventually reaches a steady state is highly idealized schema of events. In a matter of fact, the population does not set in one spot, and constantly fluctuates around some average level, in accordance with changing conditions. The magnitude of these fluctuations can be very different.

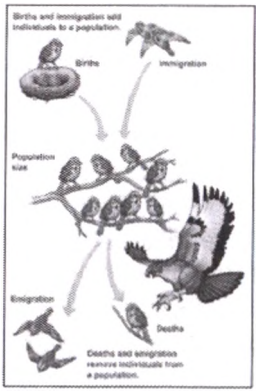
There are three *types of population dynamics*: stable, volatile and explosive.

1. **Stable type**–differentiated by small scale of fluctuations (in several times, but not by several orders of magnitude). It is characteristic to species with a well-marked mechanisms of population homeostasis, high survival, low fertility, long life, a complex age structure, advanced care of posterity. The whole complex of effectively working regulatory mechanisms "keeps" these populations within the density borders. There are, for instance, the population dynamics of large mammals and birds, as well as some invertebrates.

2. **Variable or fluctuate type**–the fluctuations occur in a large range of densities differing by one to two orders of magnitude. There can be differentiated three phases for fluctuate cycle: growth, maximum, rarefaction of quantity. The return to a stable condition occurs quickly. Regulatory mechanisms do not lose control over the populations' quantity, increasing its efficiency followed by the increase in density. It is dominated by weakly inertial inter and intraspecific interactions. This type of population quantity is widely spread in different groups of animals.

3. **Explosive type** -with outbreaks of mass reproduction-termination of the modifying factors does not cause the rapid return of the population to a stable state. The dynamics of the population quantityconsists of cycles, which distinguish five educational phases: quantity increase, maximum, dilution, depression, recovery. It is periodically characteristic for the populations to have an extremely high and an unusually low quantity rate. According to the phases of the cycle the indicators of reproduction also may significantly change, the age and sex structure of the population, physiological state, behavior, and sometimes the morphological characteristics of the individual's constituents. Thistype of quantity is most often found in species with low life expectancy, high fertility, rapid turnover of generations. It is typical, for example, for some insects (locusts, forest pests-barbell, bark beetles, somelepidopterans and sawflies etc.), between mammals can be mentioned many types of small rodents.

Population Dynamics



- **Characteristics of Dynamics**
  - Size
  - Density
  - Dispersal
  - Immigration
  - Emigration
  - Births
  - Deaths
  - Survivorship

Figure. 11. *dynamics of population population*

The type ofquantity dynamics – is more population type, but not specific characteristics. The populations of the same species in different conditions may be characterized by different types of quantity dynamics. Thiscan be explained mainly by the fact that among the regulatory mechanisms, the interspecific relationship play an important role, and it can have different degrees of intensity withinthe range of species. (Fig. 11). This way, many species, which in natural conditions hampered by enemies, demonstrating tendency to outburst of mass reproduction in gardens and fields, where the biological control is weakened.

Population size regulation

The modern theory of population dynamics considering the fluctuations in population size as an auto adjustable process. There are two fundamentally different sides of population dynamics: modification and regulation. For anyorganism'spopulation, there is a certain average level of quantity in specific conditions, around which the fluctuation occurs. The deviation from this average level have magnitude, when in norm state, the population size is changing in a negative direction after each deviation.

Modification – is an accidental deviations of population size, that occur as a result of various factors not related to population density.

Regulation- is the return of the population to its original state after the deviation, under the influence of quite different factors, and its power and activityare determined by the density of the population.

Modifying factors when causing population change, do not experience the impact of these changes on itself.The effectof it, thus, is unilateral. To the factors modifyingthe size of population we can refer all abiotic effects on the organism itself, the quality and quantity of its feed, the activity of enemies, etc. A favorable natural environment can cause a mass outbreak of species' breeding and overpopulation of its territory, as in the case of locusts. On contrary, the negative impact of modifying factors reduces population size sometimes to its complete disappearance. (Fig. 12)

The second group of factors relates to the population size regulators. Regulation is the bilateral interaction. It is based on the principle of negative feedback, when population growth causes increasing resistance to this growth. The activity of regulatory factors depends on the population density. The higher the number of species, the stronger the growth of resistance. When the quantity of population declines the impact of regulators becomes weaker. According to this principle, the population is affected as by other species so by the growth of its own density.

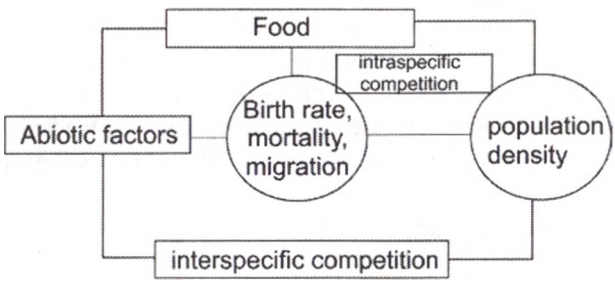


***Figure. 12**-Factors of intrapopulation size regulation*

Indeed, the higher the number of victims, the more food for predators and parasites, the faster can be spread pathogens of dangerous diseases and the stronger intensifies competition within individuals of the same species.

Thus, factors, that are regulating the size of population, i.e., return it to a normal state from overstraining, have *primarily interspecific and intraspecific relationships, i.e. biotic connection.* It is those relationships, that hold the

density in certain limits, not allowing the species to get to the critical state - undermining its own resources.

An increase inpopulation density of victims means an increase in forage for predators. The volume of prey for predators is increasing. For example, an ermine can get per one hunt, with an abundance of mice, not just one but three or four individuals - more than it can eat. This is a *quick immediate reaction* of the victims, and it can often stop the growth in its population numbers. There changing type of victim's population dynamics appears by the principal of negative feedback. It is typical for the species in areas where they have a lot of permanent enemies-consumers. Any increase in the number of species calls an immediate backlash to repress this population.

The predator's immediate reaction is not always able to slow down the growth in the number of victims, because any individual consumer has a limit of saturation.

If victims are multiplying faster than being catch by predators, then the populations of this species continues.

However, besides the immediate reaction of predators to the number of victims there is anothertype of reaction - *delayed reaction*. It is connected to reproduction of predatorsthemselves. The numberof predators and, consequently, the number of consumed victims increasesin geometric progression, and its regulatory effect on victim's populations increases dramatically. The number ofermines, for example, after an abundant by forage year with an increase of 30-50 times, itspopulation increase in 120-200 times.

In intraspecific relationships, there are also immediate and delayed reactions to its own density. For example, the territorial animal behavior reflects on the number of this generation, but falling fertility of females or an increase in the proportion of males will have an impact only on the number of future offspring.

Thus, some regulating factors would stop the growth density populations immediately, others with a delay. And this determines the type of dynamics in population number. If delayed reaction is dominating or the enemies are temporary being removed from the species, theexplosions in population numbers take place.

What happens if the anthropogenic impact weakens the regulatory bonds in nature? A striking example of this is the spread of agricultural pests. Before the industrial farming species that we call pests were not pests because they didn't thrive in such quantities, since they were under the influence of many regulators. When continuous cultivation of land united by communities of

species, the type of dynamics of many insects, fed by the cultural plants, turned from a stable type into highly volatile or explosive, creating a lot of trouble forhuman.

Contemporary representation of the population dynamics to predict the progress of the possible number of individual species as well as increasing or decreasing the regulatory context when managing these numbers. A prerequisite requirement for this is a deep exploration of environmental competitive relationships of populations.

Test tasks for self-control:

1. Different types of inhabiting a common territory.
2. One species interbreed freely among themselves.
3. One species that inhabit a certain space.
4. One species that share a common origin, coexist within a particular locality, freely interbreed.
5. One species inhabiting a specific continent.

Test 2

As a species, represented by only one population, inhabiting only in this area, and not in others?

1. Endemic species.
2. Ephemeral species.
3. local species.
4. The quarantine species.
5. Rare species.

Test 3

Which scientist suggested the use of the term "population"?

1. V.I. Vernadsky.
2. S.S. Chetverikov.
3. V.V. Dokuchaev.
4. N. V. Timofeev-Ressovsky.
5. I.I. Schmalhausen.

Test 4

Gender structure of populations depends primarily on:

1. Biological features of the species.
2. Status of environment.
3. Periodic oscillations.
4. Availability of food.
5. The presence or absence of predators.

Test 5

The population of wolves in the woods on waged during several decades:

1. Constantly increases.
2. Constantly diminishing.
3. First increases, then decreases.
4. does not change.
5. Is determined by the quantity of food resources.

Test 6

Who first proposed a mathematical model that describes the number of oscillations in the predator-prey "?

1. V.I. Vernadsky.
2. V.V. Dokuchaev.
3. A. Volterra.
4. S. S. Chetverikov.
5. I.I. Schmalhausen.

Test 7

Eliminate incorrect position among the following explanations:

Animals mark their territory, which allows them to:

1. Find their cubs.
2. Avoid collision with other organisms of the same species.
3. To meet their needs in conditions of existence.
4. Prevent the human territory.
5. Find your home.

Test 8

Cannibalism is widely used withinthe fishspecies like Burbot cod, Balkhash perch – an adult fish eatsits fry. How to explains this behavior?

1. This is an example of intraspecific competition.
2. Adults use nutrients benthos and plankton that feeds on juveniles.
3. It is a consequence of the struggle for existence.
4. This is one of the atrocities of the world.
5. This is an example of interspecific competition.

Test 9

The main reason for the decline of biodiversity on Earth is:

1. hunting.
2. A collection of medicinal herbs.
3. changing habitats and natural degradation of environment.
4. Accommodation in biocenoses of new species, which are displacing the original species.
5. Useof plants and animals for food by humans.

4.1. Community Ecology: the concept of ecosystem, biogeocenosis; mechanisms for sustainability (homeostasis and ecological succession), the main forms of interspecific relationships in the ecosystem

4.2. The ecosystem as structurally functional unit of the biosphere. Energy in ecosystems. Photosynthesis and chemosynthesis, the flow of energy and the cycling of chemical elements in the ecosystem

4.3. Ecological pyramids. The Law of Lindemann. The trophic structure of biocenosis; ecosystem's productivity

The concept of ecosystem

Synecology (from Greek syn-together), or ecology of communities (biocenology), examines the population's associations of different types of plants, animals and microorganisms that form biocenosises (communities), theways ofits formation, development, structure and dynamics, interactions with environment factors.

The diversityof living organisms can be found on Earth in any combination, and during the process of living together they create the biological unity of the *community*, or *biocenoses*.

The term "biocenose" (from LAT. BIOS — life, cenosis — general) was proposed by K. Mebius in 1877, when he studied the oyster banks and organisms confined to it. According to his definition, biocenosis is the "Association of living organisms, corresponding by its composition, the number of species and individuals of some average environment levels; the union, in which organisms are connected by mutual dependence and preserved through continuous breeding in certain places. Since Mobius times (1825-1908) in the term "biocenosis" often can be put another content. The following definition has got a widespread: biocoenosis – *a set of populations of all alive organism's species inhabiting aspecific geographical territory, different from other neighboring territories by chemical composition of soil, water, as well as byseveral physical parameters (height above the sea level, the amount of solar radiation, etc.)*Thus, the composition of biocenosis includes such components as *plants*.It is represented by one way or another plant community – *phytocenosis*, animal component – *zoocenosis: microorganisms*. It creates microbial biocomplexes in thesoil, water or air environments – microbiocenosises. Specific communities have been developed in well-defined

environment circumstances (soil and groundwater, climate, precipitation). During interaction with components of biocenosis (plants, microorganisms, etc.), soil and ground water creating edafotop, and the atmosphere creates climatop. The components, related to inanimate nature, creating the stagnant unity - ecotope. A relatively homogeneous space, based on abiotic factors of environment, occupied by the biocoenosis is named biotope.

The adaptability of biocenosis members to the conjoint live is expressed by a certain similarity of requirements to the critical abiotic environment conditions and natural relations with each other (fig. 13).

Biocoenosis and biotope mutually affect each other, manifested mainly in a continuous exchange of energy between two pillars and inside each of them. The scale of biocenotic groups of organisms is quite different, from communities, for instance,such as pillows of lichens onthe trunks of trees ordecaying tree stump to the landscapespopulation: forests, steppes, deserts etc. In relation to small communities (stems or foliage of trees, mossy tussocks onswamps, anthills etc.) are used such terms as "microcommunity', "biocenotic groupings", "biocenotic complexes", etc.

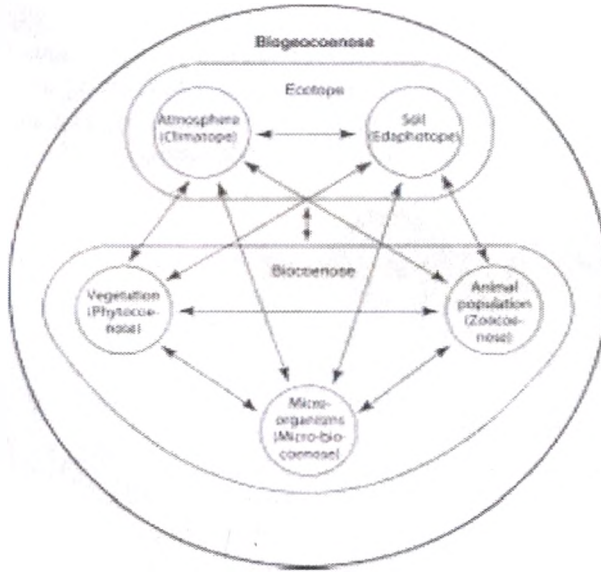


***Figure. 13** - the structure of biocenosis and interaction scheme between its components (in n. Solution, 1940)*

There is no principal difference between biocenotic groupings of different scales. Small communities areparts, by its integral and often autonomous side, of the larger, which are part of the communities of greater proportions. For example, all living populations of mossy and lichen's pillows on a tree trunk is part of a larger community of organisms associated with this tree and including its sub-crustal and afterburner inhabitants, the population of krone,rhizosphere etc. At the same time, this grouping is only one of the composite components of forest biocenosis,which included into more sophisticated complexes that form the whole live cover of the Earth in the end. Therefore, the Organization of life on biocenotic level has a strict hierarchy. The increase in scale of communities increases its complexity and proportion of indirect, obliqueconnections between species.

Species, in biocenosis also form a certain **spatial structure**, especially in its vegetative parts- fitocenosis. First, there is clearly defined a vertical longline structure in the temperate and tropical forests. For example, in calcareous forestscan select five or six tiers: first – trees of first magnitude (Oak, Basswood, Elm); second - trees of second magnitude (Sorbus, Apple, Pear, Prunus, etc.)third - is anunderbrush (Rhamnus, Honeysuckle, etc.); fourth - consists of tall grasses, andfifth and sixth, thereafter, from lower grasses. A stratification allowsthe plants to make fuller use of the luminous flux - in the upper tiersare light-loving, in the bottom tiers – shade-loving and, at the very bottom, catchingthe rest of the light shade-loving plants. The stratification is expressed in herbaceous communities, but not so clearly as in forests. (Fig. 14)

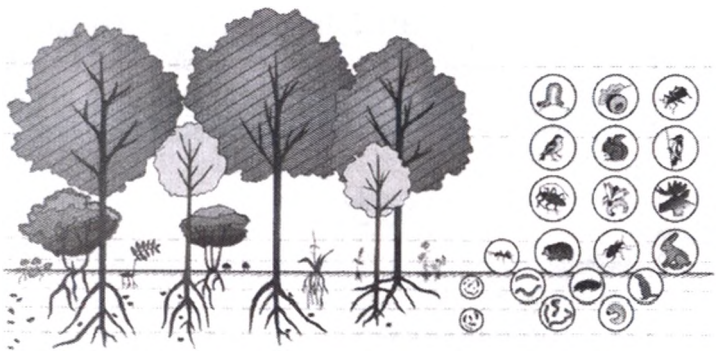


Figure. 14- Tiers of forest biocenosis (I.N. Ponomarev, 1978)

In the vertical direction, under the influence of the vegetation changes, including not only the close alignment and increase in temperature, but also change of the gas composition due to changes in flows of carbon dioxide during the night and day, allocation of sulfurous gases by chemosynthetic bacteria, etc.

The microenvironment's changes contribute to education and certain stratification fauna-from birds and insects to mammals.

In addition to the stratification in the spatial structure of biocenosisthereis a ***mosaicism***of vegetation changes and fauna horizontally being observed. The diversity mosaicism depends on biodiversity of species, its quantitative relationships, variability of the landscape and soil conditions. Themosaicism can arise as the result of human activity (selective felling, fire, etc.) or animal's activity (soil emissions and its subsequent invasion, ant hills formation, trampling and grass utilization by ungulates, etc.), windfalls of stand during hurricanes, etc.

The basic forms of interspecific relationships in the ecosystem

Neutralism - is a form of biotic relationships when the cohabitation of the two species in one area does not entail neither a positive nor negative impact on them. In this case, species are not directly related and even contact between each other (a squirrel and moose). Theneutralism relations are characterized by rich variety of species in the communities.

Amensalism – are biotic relationships when there is a growth brakingof one typ inhibition (amensala) by product allotment of other. This type of relationship is commonly referred to direct competition and called antibiosis. For example, the allelopathy in case of plants, when applying different poisonous substances to fight competitors for resources.

Predation and parasitism. Predators are animalsthat eating other animals. They are characterized by hunting behavior. However, the activities of the insectivorous predators are a simple "gathering" of prey like pasture in case of herbivores.

Parasitism (greek "parasitos" – reeloader) is a form of relationshipof two organisms, one of which (the parasite) uses another (host) as a food source and habitat environment, causing him harm, but not causing immediate death.

Parasites are divided into obligate (mandatory), that cannot complete its life cycle without a master, and optional parasitizing only under certain environment conditions. For example, optional parasite is a round worm –

intestinal oyster, which inhabits in the soil asa free-livingbody, but under adverse conditions it turns into a parasitic lifestyle in the human small intestine.

Depending on the degree of connection with the host there are distinguished permanent and temporary parasites. Temporary parasites attacking the host only for food, for example, blood sucking mosquitoes, ticks, etc. Permanent parasites live in the host organism for most of its life. Permanent parasites can use only one hostthroughout the life cycle, such as humanascaris; or to move from one host to anotherfor successful implementation of consistent stages of development(bull tapeworm, liver fluke, etc.).

Regardingthe habitat location there can be highlightedectoparasites, living on the surface of the host body (mite, sarcoptes), and endoparasites, living in the inner cavities (roundworm, pinworm), tissues (larvae of tapeworm) and the host cells (malaria Plasmodium).

In the parasite's life cycle the changeof ownersoccurs frequently. The owner, in whose body thee mature stage of parasite inhabitsand multiplies sexually, called as the final. The owner, in whose body the parasite reproduces asexually orparthenogenically is known as an intermediate.

Symbiosis (from greek sin – together,bios-life) is a form of interspecific interactions in which both partners (or one of them) get benefited from living together. Symbiotic relationship in nature are presented in a variety of forms, where the most common types are proto-cooperation, commensalism and mutualism.

Commensalism (from Latin com-together and mensa-table, meal) – a type of relationship in which one of the two species living together benefiting from joint existence, harmless one to another. An example of a commensalism isrelationships of fish-pilots and large marine predators (sharks, dolphins). By accompanying them, pilots receive protection from enemies and predator's food remnants (sponginess). We can also refferto sponginess - hyenas eating Lion'sunfinished prey. One of the forms of commensalism is lodging, when onetype of species uses as a refuge habitats (dwellings) or organisms of another type. Fish oxtongue, for example, spawn, living in themantle cavity of bivalve shellfish. Fry fish hiding under the umbrellas of large jellyfish, and adult fish staying for a long time between long needles of sea urchins. The lodgers often eat remnants of food and excrement of the owner, such as amoeba, lives in the human oral cavity, or invertebratesanimals-sarcophagus, settling in themammals' holes and bird's nests.

Protocooperation –is joint existence, advantageous for both species, but it is not an obligation for them. The classical example of this form of symbiosis

can be the settlement of a single coral polyp to an empty clam shell. The shell can be used as an asylumby the cancer-hermit that hides there its soft belly. By moving on the bottom, cancer makes it easier for actinia to catch the prey, part of which falls to the bottom and eaten by the cancer.

Mutualism (Latin mutus - common) - is a form of interaction between organisms, bringing benefits for both partners, that cannot live independently. A typical example of mutualism – relationship of termites andflagellates protozoa inhabiting their gut. Termites are unable to ferment cellulose, while flagellates produce enzymes that moves it into sugars which are easily absorbed by termites. The ciliates enjoy favorable environment of intestine conditions and the food in it. Similar way, hoofed animals are using enzymes, living in the stomach and in the gut of mutualistic organismsforfiber digestion. Another example of mutualism can serve the relationship between legumes and nitrogen-fixing bacteria on the roots of plants forming tubers. When this tubercle bacteria assimilate molecular nitrogen from the air, transforming it into compounds, digestible by plants, which in turn providing the bacteria with nutrients.

The concept of ecosystem and biogeocenosis, its classification. Structural organization of ecosystems. Energy systems, food chains and networks, ecological pyramids

The notion of ecosystems and biogeocenosis, its classification

Living organisms and their living (abiotic) environment are inextricably linked to each other, and are in constant interaction. Any unit (biosystem), that includes allthe jointly operating organisms (biotic community) on this site and interacts with the physical environment so that the flow of energy creates a clearly defined structure and cycles of substances between the animate and inanimate parts, is represented as an ecological system. Ecological system, or ecosystem, is the basic functional unit in ecology because it is composed of organisms and non-living environment – components, mutually influencing each other's attributes and the conditions necessary to sustain life in the manner that exists on Earth. The term "ecosystem" was first suggested in 1935 by the British ecologist Arthur Tansley (1871-1955).

The idea of the ecosystem has occurred much earlier. The mention oforganism and environment unity can be found in the most ancient written monuments of history. However, only in the end of XIX c. statements of this kind have emerged, almost simultaneously in the American, European and

Russian literature (k. Möbius, 1877; C. Forbes, 1877; v. Dokuchaev, 1886, etc.).

Currently, the following definition of ecosystem is widespread. *Ecosystem – is any set of organisms and the inorganic components where cycles of substancesmay occur.* By N. F. Rejmers (1990) definition - *ecosystem – is any community of living beings and its habitat, that is united into a functional unit, that occurs based on interdependence and cause-effect relationships that exist between individual environmental components.* It should be emphasized that a set of specific physical-chemical environment (biotope) with a community of living organisms (biocoenosis) form an ecosystem. A. Tansley (1935) proposed the following ratio:

Ecosystem = Biotope + Biocoenosis

The term biocenosis is widely used in the domestic literature, as proposed in 1942 byN. Sukachjov. According to his definition, biogeocenosis -"is a collection ofnatural homogeneous phenomena (the atmosphere, rocks, soil and water conditions) over known Earth's surface, which has its ownspecialspecificity of interactions of these sectors of its components and certain type of substance and energy exchange among themselves and other phenomena of nature. It represents the internally contradictory dialectical unity that is in constant motion, development". V. N. Sukachev illustrates the block model in the biogeocenosis rankas on Figure 1. 25.

Biogeocenosis, by V. N. Sukachev, includes all the mentioned blocks and links. This term is usually used in relation to land systems. In biogeosenosis the presence of plant community (phytosenosis) is necessary.Examples of biogeocenosis– are similar stretches of forest, meadows, prairies, swamps, etc.

Also, ecosystems may not have vegetable link. An example are systems, formed based on decomposing organic debris, trees rotting in the forest, dead animals, etc., There is enough of zoocenosis, microcenosis or only microbiocenosispresence that is capable to proceedmicro-circulation of substances.

Thus. each biogeocenosis may be called ecosystem, but *not every ecosystem refers to the rank of biogeocenosis.* To remove terminological ambiguities, the co-authorof V. N. Sukachovon formation of biogeocenologics, professor V. Dylis is figuratively defined biogeocenosis as an ecosystem, but only within the framework of the phytocenosis. (Fig. 15)

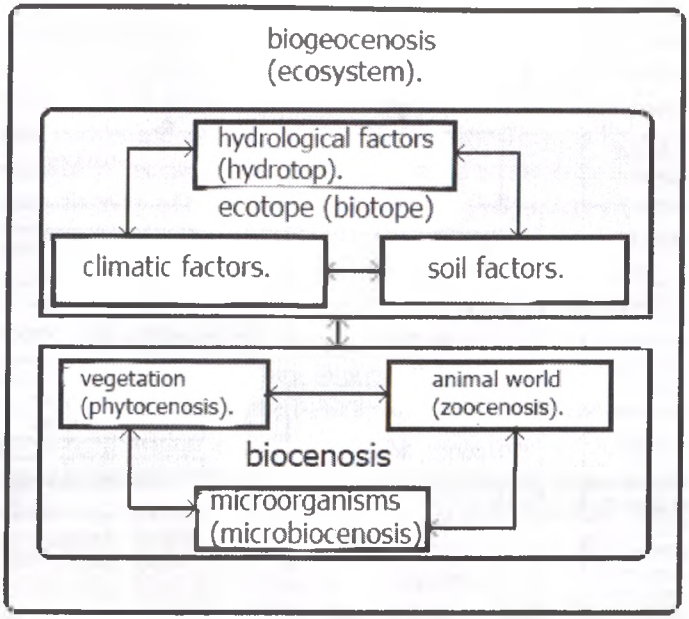


Figure 15 *- Scheme of biogeocenosis (ecosystems) by V. N. Sukachov*

Biogeocenoses and ecosystems mayalso vary by time factor (durationof existence). Any biogeocenosisis potentially immortal, since the energy replenishes all the time due to the activity of vegetable photo or chemosatizing organisms. At the same time, without plant managers the ecosystemfinishesits existence simultaneously with the release of energy of the entire substrate decomposition process contained in it. However, it should be kept in mind, that, currently, the term "ecosystem" and "biogeocenosis" are often treated as synonyms.

The ecosystems existing on Earth are varied. There are emitedmicro-ecosystems (for example, the barrel of rotting wood), meso-ecosystems (forest, pond, etc), macro-ecosystems (continent, ocean, etc.) and as global- biosphere (Fig. 16).

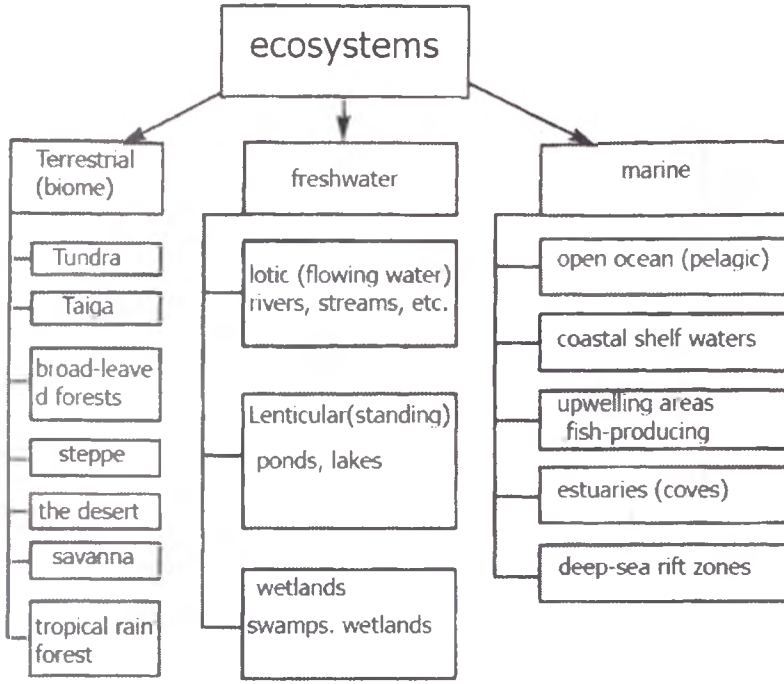


Figure. 16 *- The main types of biocoenosis*

Large terrestrial ecosystems are called biomes. Each biome includes a set of smaller interconnected ecosystems. There are several classifications of ecosystems

Terrestrial Biomes here highlighted by natural or original characteristics of vegetation, and the aquatic types of ecosystems by geological and physical characteristics. There are sixteen major ecosystem types listed on the table.3 that constitute that environmentwhere human civilization has developed, and represents the main biotic communities that support life on Earth.

The study of the geographical distribution of ecosystems can be done only at the level of major ecological units – macroecosystems, which are reviewed on a continental scale. The ecosystems are not scattered in disarray, on the contrary, it is grouped in a regular area, both horizontally (latitude) and vertically (height). This is confirmed by ***the periodic law of geographical zoning by A.A. Grigoriev - M.I. Budyko:*** with the change of Physic-geographical zones of the Earth, similar landscape zones, and some of its

common characteristics are periodicallyrepeated. This is what it was about when considering ground-air environments of life. The structural organization of ecosystems can be considered from two perspectives: *trophic and biological.*

As the **species structure,** we understand the number of species that creating the ecosystem, and the ratio of its quantity. There is no accurate data on the number of species in the ecosystems. Due to the fact, it is difficult to consider the diversity of all small organisms (especially micro-organisms). It is estimated in hundreds and tens of hundreds. Usually,the greater the species diversity the richer the conditions of ecosystem (biotope).This way, for instance, the richest in species diversity arerain rainforest ecosystems. Only tree species are calculated in hundreds in it.

Species biodiversity is a very important characteristic of ecosystems. As noted above, the resistance to the adverse environment factors is connected to it. The diversity provides, so called, security - a duplication of sustainability. The species that exists only as a single exemplar can dramatically increase in number under adverse conditions for widely spread species, including the dominant species, and thus can fill the vacated space (ecological niche), preserving the ecosystem as one whole.

Species structure is usually used to evaluate the conditions oflocation by the plants indicators. For example, in the forest zone, oxalis is pointing on conditions of moisture to be close to the optimum, and a significant wealth of soil with nutrient minerals; blueberry points on little excess of moisture and some shortages of mineral elements; Cranberries point on lack of moisture and soil fertility; mosses (cuckoo flax and especially sphagnum) points on overly excessive moisture, mineral deficiency, lack of oxygen for respiration of the roots and the presence of peat formation processes. Along with indicators, the composition ofother species growing under the canopyof edifiers is changing too.

Titles of ecosystems (biocenosis). Depending on the plants-edifiers or dominants and plants-indicators, biogeocenoses (ecosystems) are commonly named. Foresters determine it as forest types (for example, spruce-sourer, spruce-arbutus, spruce-sphygonic, etc.).

Mechanisms for the sustainability of ecosystems
Cyclicity

of ecosystems – is a dynamic process. There are constant changes occur in the ecosystems in its condition and functioning of members and the ratio of

populations. The diverse changes that occur in any community arereferred to two main types: cyclic and progressive.

Cyclical changesof communities reflect the daily, seasonal and multi-year periodicity of external conditions and manifestations of endogenous rhythms of organisms. Daily dynamics of ecosystems is mainly connected with the rhythm of natural phenomena and has a strictly periodic nature. Some of these are active during the day, some at night. Hence, in the composition and in the ratio of individual types of biocenosis, periodic changes occur as separate organisms for a definite time frame get out from it. Daily dynamics of biocenosis is provided by both: animals and plants. As known, within days, the intensity and nature of physiological processesof plants are changing, -while photosynthesis does not occur at night, often the plant's flowers are revealed only at night and pollinated during the day time. Generally, the stronger the daily dynamics of biocenoses is expressed the greater the difference in temperature, humidity and other environment factors during day and night.

More significant deviations in biocenoses is noted during the seasonal dynamics. This is due to the biological cycles of organisms that depend on seasonal cyclical phenomena of nature. So, the change of seasonsheavily influencees the vitality of animals and plants. To the seasonal variability also often exposed the tiered structure of biocenosis. Separate tiers of plants during corresponding seasons may completely disappear, for example, herbaceous tier consisting from ephemeral layer.The duration of biologicalseasons in different latitudes varies. In this regard, the seasonal dynamics of biocoenoses of boreal, temperate and tropical zones differs. It is expressed the clearest in the ecosystems of the temperate climate and northern latitudes.

Perennial cyclicity is expressed due to climate fluctuations. Fluctuation (from latin fluctuatio - fluctuation) is a relatively short-term change when the community, without changing the floristic composition, deviating from the median state due to seasonal and weather climate changes as well as s the dynamics changes of the animal component of the ecosystem or methods to use it. The perennial cyclicity, in the changes of biocenosis, revealed sharply by erratic rainfall by the years, with periodic repetition of droughts, and it is well illustrated by the repetition of mass reproduction of animals, such as a locust (a locust touches).

The perennial cyclicitycan related to the peculiarities of plants-edifiersdevelopment. For example, in the beech forest serriedcrowns of perennial trees are hurting the vegetation of the tiers below, but as soon as the

beech falls, the young trees begin grow rapidlyand crown recovers.This way the beech forest is being updated, which naturally requires a loop of 250 years.

Periodically recurrent dynamicsis called as cyclical changes or fluctuations, and the directed dynamics is called as progressive or the developmentof ecosystems. For the latter type of dynamics, it is characteristic either introduction of new species into ecosystems or exchange of one species onto inother.

Progressive changes in the ecosystem eventually leading to a change of one biocenosis onto another, with a different set of dominant species. The reasons for such shifts may be external to the biocoenosis factors, operating in one direction for a long time, for example, the increasing pollution of water reservoirs, is increasingbecause ofamelioration desiccation of bog soil, intensive grazing, etc. Those changes of one biocenosis onto another are calledexogenetic. In case when amplifyingeffect of the factor leads to the gradual simplification of the structure of biocenosis, impoverishment of its composition, decreased productivity, such shifts are called digressive or digressions.

Endogenetic changes arise from processes that occur inside the biocenosis.

The sequential replacement of one biocenosis with another is called environmental succession. Succession is a process of ecosystems' self-development. At the succession foundation lies the incompleteness of biological cycles in that biocenosis. It is known that living organisms because oflivelihood are changing the surrounding environment, withdrawing from it some part of the substances and saturating it with the products of metabolism. With the relatively long existence of the populations they are changing their surroundings unfavorably, and as a result they turn outto be marginalized by the populations of other species, for which caused by the conversion of environment turn out to be environmentally beneficial.Thus, the change of the dominant species occurs in biocenosis. Here, can be clearly traced ***the law ofecological duplication.***

The prolonged existence of biocenosis is only possible if the environment changes, induced by the activity of one living organisms are favorable for the others with conflicting requirements.

Successions in nature are extremely multiscale. It can be observed in the banks with cultures, representing planktonic communities -different types of floating algae and its consumers - rotifers, flagellates in puddles and ponds, marshes, meadows, forests, abandoned arable lands, weathered rocks, etc.

Types of successional changes

There are two types of *successional changes:*

1-with the participation of autotrophic and heterotrophic population;
2-involving only heterotrophs.

The succession of the 2nd typeis realized only in such circumstances where it is createdpreliminary stock or continuous supply of organic compounds, due to which the communityexists: in the heaps or manure stacks, decaying plant mass, polluted water by organic substances etc.

The process of succession.

By F. Klementson (1916), the process of succession consists of the following steps: 1. the emergence of unoccupied area. 2. Migration toit of various organisms or its germs. 3. Its survival on this site. 4. Competition between themselves and the crowding out of individual species. 5. Transformation of the habitat by living organisms, gradual stabilization of conditions and relations.

The succession with the change in vegetation can be *primary* and *secondary*.

Primary succession is the process of developmentof ecosystem change in previously uninhabited areas, starting from its colonization. A classic example is the constant fouling bare rocks and, eventually, the development of forests on it. So, in primary successions that occurred on the rocks of the Ural Mountains, there aredistinguished following steps:

1. The settlement of endolytic and accumulative lichens, completely covering the rocky surface. The scaling lichens bear a distinctive flora and fauna and contain a rich fauna of protozoa, rotifers, nematodes. Small pliers-saprophagous and primary winglessinsects are detected at first only in the cracks. The activity of the total population is intermittently, and stands out mainly after precipitation as rain or wetting of rocks with moisture mists. The given communitiesof organisms are named as pioneer.

2. The predominance of leafy lichensgradually create a continuous carpet. Under the circles of lichens, because ofits acids and mechanical reduction of the thallus during drying, the deformity is being formed, there is a process of thallus dying and the accumulation of detritus. In large quantities under the lichens can be found small arthropods: collembols, armored mites, mosquito larvae, senoids and other. The micro-horizon is formed out of its excreta.

3. The settlement lithophilic mosses Pleurozium schreberi and Hedwigia. The lichens and subliminal film soils are burying underneath it. The rhizoids ofmoss here aren't attached to the stone, but to the fine earth, which has a capacity of not less than 3 cm. The temperature fluctuations and humidity beneath the moss is several times smaller than under the lichens. The microbial activity amplifies, the diversity of groups of animalsincreases.

4. The emergence of the hypnotic mosses and vascular plants. In decomposition of plant residues and the formation of the soil profile, the role of small arthropods slowly diminishes while the participation of larger invertebrates –saprophagous is growing: enchytraeids, earthworms, insect larvae.

5. The occupancy by the large plants, contributing to the further accumulation and the formation of soils. Its coat comes out to be enough for the development of shrubs and trees. Its fallen leaves and branches do not let the mosses and most other small species to grow, that had started the succession. This way, gradually, on the initially bare rocks there is a process of lichens being exchanged by mosses, grasses and, finally, by forest. Such successions in the geobotany is named as ecogenetic, since it leads to the transformation of locality. The example of succession on (pic. 17)

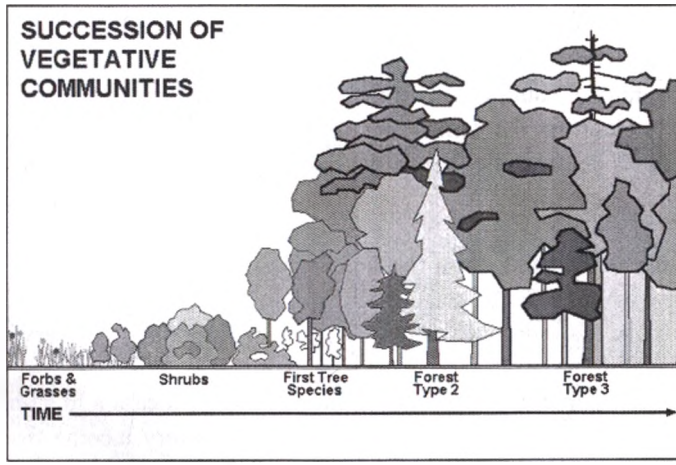


Figure. 17 - The example of succession developmentof cedar-fir forest

Secondary succession is the recovery of an ecosystem, thathad already existed once on this territory. It starts in case when already established

biocenosis has the existing organism's interrelations being violatedas a result of fire, cutting, tilling, etc. An example can be found in secondary succession of the Siberian dark coniferous forest (fir-cedar Taiga) after the devastating forest fire.

Onthemost blastedfieldsfrom spores brought by wind, there appear mosses-pioneers: via 3-5 years after the fire, the most abundant are "firefighter-moss. From higher plants very quickly populate the fumes Ivan-tea, which is already a month 2-3 profusely flowering on the Inferno, as well as ground reed and other species.

There has been a further passage of succession phases: reed meadow is changing by shrubs, then by birchor aspen forest, mixed pine-leaf forests, pine forest, pine-cedar forests: and, finally, through 250 years restoring cedar-fir forests.

The value of ecological succession

The mature community with its great variety, saturation of the organisms more evolved trophic structure, with a balanced energy flow can withstand changes of physical factors (such as temperature, humidity) and even certain types of chemical pollution to a much greater extent than the young community. However, the young community can produce a new biomass in much larger quantities than the old one.

Thus, human could collect a rich harvest in the form of clean products, artificially supporting the community in the early stages of succession. After all, a mature community, being at the stage of menopause, net annual production is spent mostly on the plant's and animal's respiration and may even be zero.

On the other hand, from the human point of view, sustainabilityof the community, which is in the stage of climax, its ability to withstand the effects of physical factors (and even control it) is very important and very desirable feature.

It is extremely important that human pays equal attention to both types of ecosystems. If destroy the forest in pursuit of temporary income from wood, water reserveswould decrease and soil would be demolished from the slopes. This reduces productivity in lowland areas. Forests are for humans only value as suppliers of wood or source of additional areas that may be employed in cultural plants.

Unfortunately, people rarely realize the consequence of environmental violations that arise in the pursuit of economic benefits. Partly, this is connected to the fact that even experts-ecologists still cannot give accurate predictions of the consequences that result from a variety of ecosystems mature type.

The remnants of civilization and the desert, which has appeared due to the human activities is an excellent proof that people had never realizedits close relationship with nature, the need to adapt to natural processes, rather than commanding it.

Homeostasis of ecosystems

The ecosystems are characterized by flows of energy and materialscycle, as well as by developed information networks connecting all parts of the system and administering it as a single entity. Therefore, we can say that ecosystems are having a cybernetic nature.

The ability of ecosystems to the self-support and self-government is called **homeostasis**. At the core of homeostasis is based on the principle of negative feedback. Thanks to this connection of regulated processes of storing are being released nutrients, production and decomposition of organic compounds.

Maintenance of the homeostasis of ecosystems is possible only in certain limits. Outside the scope of negative feedback comes into force positive feedback. The action of homeostasis is presented in Figure 18.

Figure. 18. The mechanism of action of homeostasis based on reverse negative and positive connection

When ending the discussion of the problem of the ecosystemsstability, we can formulate a very important environmental rule, called ruleof % 1. The change of the energy of the natural system by an average of 1% displays a system out of balance.

Stability and sustainability of ecosystems

The terms "stability" and "resistance" in ecology is usually treated as synonyms, and refers to the ability of ecosystems to preserve its structure and functional properties when exposed to external factors.

More useful, however, to distinguish between the terms, understanding by "stability" as the above mentioned definition, and the term "resistance" is the ability to return to its original ecosystem (or close to it) status after exposure to the factorsthat threwit out of balance.

Elastic system is capable to perceive the significant impact, without altering substantially its structure and properties. However, under certain

(catarrhal) influences such a system usually collapses or transfers into a new quality.

Plastic system is more sensitive to impacts, but it "yields" under its influence and then returns to its original relatively quickly or close to its original state with the termination or reduction of the force of the impact.

This way, high stability and high resistance, as can be seen from table 3, are inherent in the pine forests on poor soils, despite of species diversity of these ecosystems. This is, firstly, since pine is quite flexible, and therefore reacts to changing conditions, such as soil scaling, by declining productivity and rarely -by the ecosystem collapse. In the latter case, however, because of the poverty of the substrate with nutrients and moisture, its younger generation does not meet serious competition from other species and the ecosystem is quite fast once again restored as edaphic (soil) climax.

Thus, the outside impact causes change in speciesbiota composition, the emergence among plants and animals of sick, weak and dead animals, the reduction of vegetation productivity and other implications until the destruction of the ecosystem.

Ecosystem as structurally functional unit of the biosphere

As noted earlier, every ecosystem has two main components: organisms and itsfactors of surrounding non-living environment. The combination of organisms (plants, animals, microbes) is called *biotope*of the ecosystem. The ways of interaction of different categories of organisms – is *biotic structure.*

From the perspective of the *trophic structure* (from the Greek. trophe — food), an ecosystem can be divided into two tiers. 1. Upper tier— *autotrophic*(self-feeding) *tier*, or "green belt", which includes plants, or its parts, containing chlorophyll, where the fixing of account energyis dominating, the use of simple inorganic compounds. 2. Bottomtier -*hetero-trophic* (fed by others) *tier*, or "brown belt" of soils and sediments, decaying substances, roots etc., which is dominated by using, transformation and decomposition of complex compounds (fig. 18).

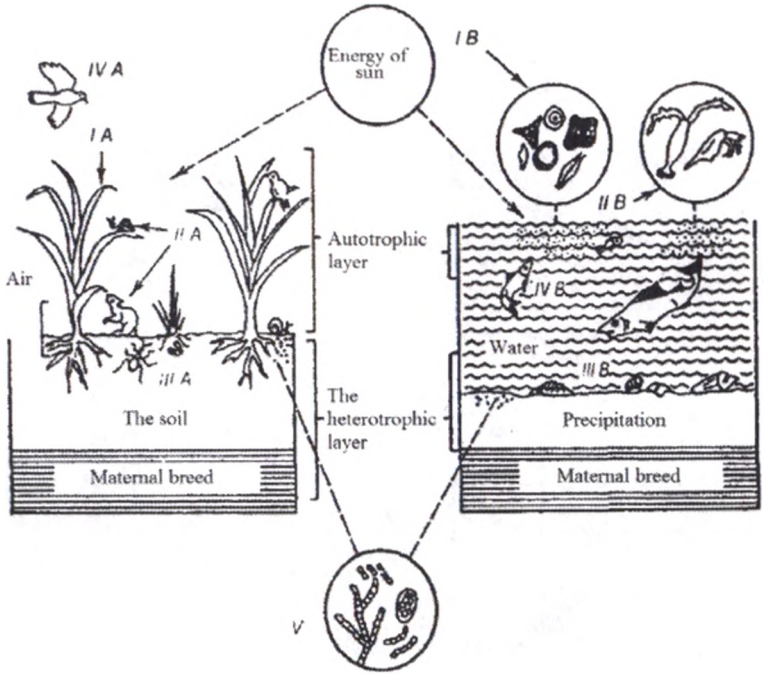


Figure. 18 *- the overall structure of the ground (grassland) and water (lake or marine) ecosystems by (J. Odum, 1986):*
I - are autotrophs: A - is grass; B - is phytoplankton. II–herbivorous animals: A - insects and mammals of grassland community; B - zooplankton in the waterstratum. (III) -detritus: A - soil invertebrate on land; B - bottom invertebrates in water. IV- predators: A - birds and other animals on land; B - fish in the water. V — saprotrophs: decomposing bacteria and fungi.

From the biological point of view, the composition of ecosystems distinguish the following components: 1) *inorganic substances* (C, N, CO_2,H_2O etc.), which are included in cycles; 2) *organic compounds* (proteins, carbohydrates, lipids, humic substances, etc.), which are connecting the biotic and abiotic parts; 3) air, water andsubstrate environment, including climatic regime and other physical factors; 4) *producers, autotrophic organisms* (green plants, blue-green algae, photo and chemosynthetic bacteria), which are producing food from simple inorganic substances (fig. 19).

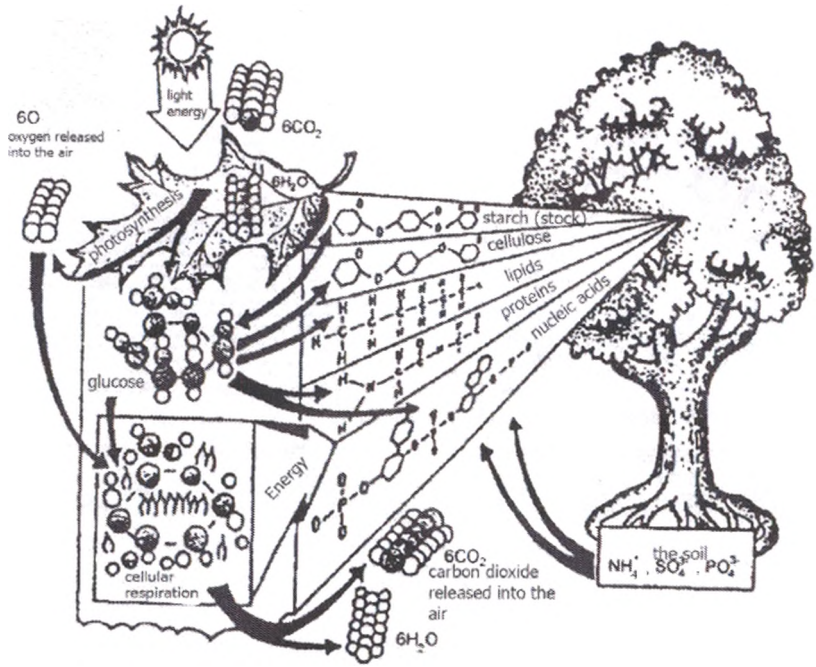


Figure. 19 *- Producers by (B. Nebel, 1993)*

5) *consumers*, or fagotroph (from Greek. phagos — predator) - heterotrophic organisms, mainly animals, that are feeding by other organisms or by particles of organicsubstances; 6) decomposers and detritus - heterotrophic organisms, mainly bacteria and fungi, that are receiving energy either through decomposition of dead tissue or by absorption of dissolved organic substances excreted spontaneously or extractedby saprophytes from plants and other organisms (fig. 20).

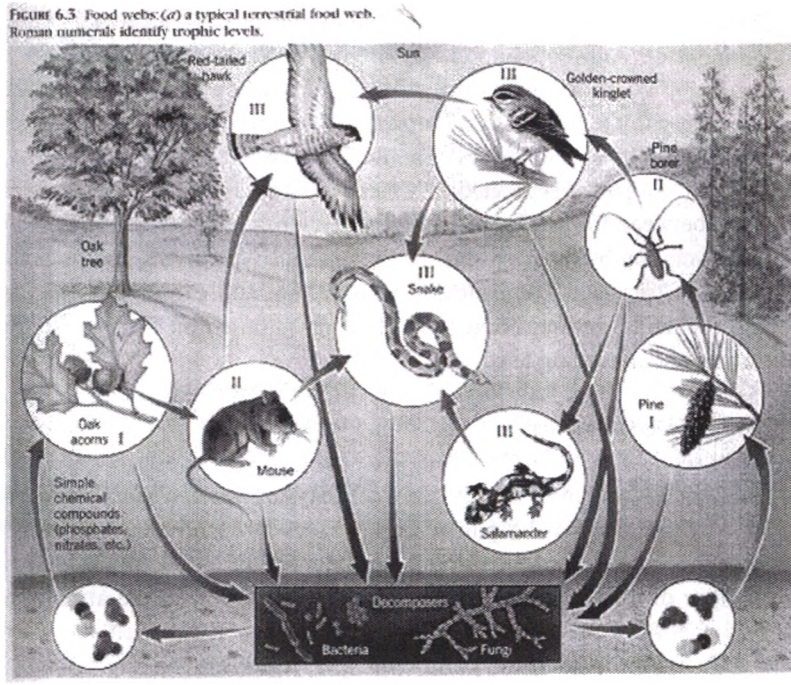


Figure 20 *- categories of ecosystem organisms*

Consumers are feed by alive (biophages) or dead (saprophagous) organic material. Among biophages can be highlighted herbivorous organisms or phytophagous (primary consumers, those include damaging plant viruses, fungi and parasitic vascular plants), carnivores (secondary consumers, including primary predators and parasites) and end users — top predators (tertiary consumers).

In the ecosystem, food and energy links between categories are always clear and go in the direction of:

autotrophs -> heterotrophs.

Or in a more complete form:

autotrophs -> primary -> decomposers (destructors).

The organisms involved in the various processes of circulation, partially separated in space. Autotrophic processesare most active occur in the upper tier ("green zone"), where sunlight is available. Heterotrophic processesproceed more intensively in the bottom tier ("brown belt"), where in soils and sediments are accumulated organicsubstances. The main functions of the components of the ecosystem are partly separated in timesince there is possible a significant gap in time between the produced organic substances byautotrophic organisms and its consumption by heterotrophs. In General, all three living componentsof the ecosystems (producers, consumer and decomposers) can be seen as three functional realms of nature, because its division is based on the type of food and the energy source being used.

Energy in ecosystems

The primary source of energy for the ecosystems is the Sun. The energy flow, sent by the Sun to the planet Earth, exceeds 20 million EJ per year. Because of the sphericity of the Earth to the edge of the entire atmosphere gets only a quarter of this thread. About 70% of it is absorbed by the atmosphere, emitted in the form of long-wave infrared radiation. Falling on the Earth's surface, the solar radiation is 1.54 million EJ per year. This is a huge amount of energy that exceeds in 5000 times the entire energy of mankind of the end of 20-th century and in 5.5 times the energy of the all available fossil fuel resources of organic origin, accumulated at least during 100 million. years.

A large part of the solar energy that reaches the surface of the planet, turns directly into heat, warming the water or soil, which in turn heats the air. This heat serves as a driving force of the water cycle, air flow and organic currents that determine the weather, and gradually goes into outer space, where it gets lost.

To determine the location of ecosystems in this natural flow of energy, it is important to understand that no matter how extended and complex it may be, it uses only a small part of it. From here it follows one of the fundamental principles of the ecosystems' functioning: *itexists thanks to the practically eternal solar energy which also doesn't pollute the environment, the amount of which is relatively constantand excessive.*Let's give more detailed of each listed characteristicsof solar energy:

1. *Excess*. Plants are using about 0.5% of the amount, that reaching the Earth. If people existed only at the expense of solar energy, they would use even less of it.

2. *Clean.* Solar energy is "clean", although the nuclear reactions in the bowels of Sun serving the source of its energy, and accompanied by radioactive contamination, all of this is 150 million. km from the Earth.

3. *Constancy*. Solar energy is always available in the same, infinite quantity.

4. *Eternity.*Scientists believe that the Sun in a few billion yearswill go out. However, for us, this has no practical significance, because people on contemporary data, are only existing for about 3 million years. This is just 0.3% of billion. Hence, if even in 1 billion years the life on Earth will become impossible, humankind has in stock 99.7% of that period, or every 100 years it will decline only by 0.00001%.

Unlike substances, continuously circulating in different blocks of ecosystems that can always be reused, to enter circulation, energy can be used once, i.e.there is a linear flow of energy through an ecosystem taking place.

The one-way flow of energy, as a universal phenomenon of nature, occurs as the laws of thermodynamics. **The first law** states that energy can transform from one form (e.g., light) to another (for example, the potential energy of food), but cannot be created or destroyed. **The second law** asserts that there can be no process associated with the transformation of energy without losses of some of its parts. A certain amount of energy in such transformations is scattered into inaccessible thermal energy and, therefore, is getting lost. Hence, there can be no transformations, for example, nutrients into the substance, that the organism's body is made of, happening with 100% efficiency.

Food chains and networks

Within the ecosystem, the substances containing energy are created by autotrophic organisms and serve as food for the heterotrophs. **Food connections** are mechanisms for the transfer of energy from one organism to another.

A typical example: an animal eats a plant. This animal in turn may be eaten by other animals. This way, the energycan be transferred through several organisms-each of subsequent is fed by previous, which suppliesit with raw materials and energy. This sequence of energy transfer is called **food (trophic) chain or supply chain**. Each unit placement in the link of the food chain is a trophic level.

*The first trophic level*are the producers, all the others areconsumers. *The second trophic level*areherbivorous consumers; *third* -carnivorous consumers, eating mainly herbivorous forms; *fourth* -consumer, that consume other carnivores, etc. and therefore, consumers can bedivided by levels: consumers of first, second, third order etc. (Fig. 21)

Clearly are divided by level onlythose consumers, that are specializing in a certain kind of food. However, there are species that eat meat and vegetable food (man, bear, etc.) and can be included in the food chain at any level.

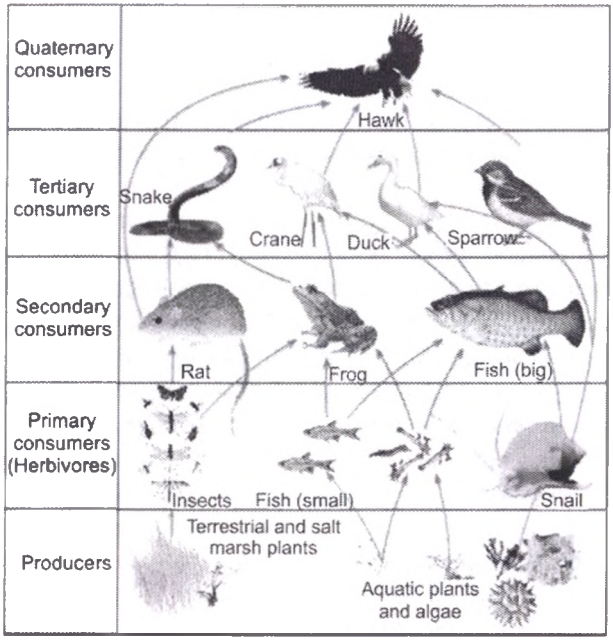
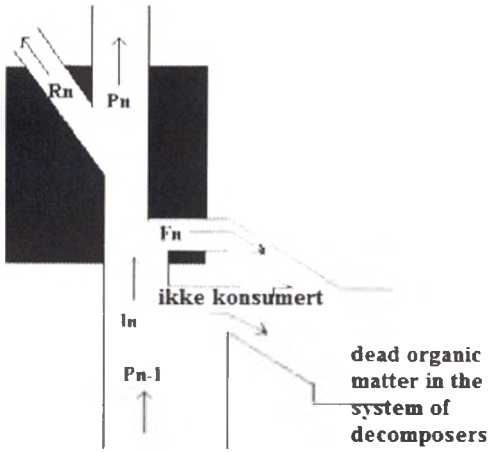


***Figure. 21**. Trophic levels of an ecosystem*

Food, that is absorbed byconsumers isn't fully digested, ranging from 12% to 20% among some herbivorous, up to 75% or more among carnivores.

Energy costs are first of all connected with (fig. 22) the maintenance of metabolic processes, which are called waste on respiration, estimated by total amount of CO_2 that is allocated by the body. A much smaller portion goes to the formation of tissues and some nutrient storage, i.e. growth. The rest of the food comes out in a form of excrements. In addition, a significant part of the energy is dissipated as heat in chemical reactions in the body, and especially with the active muscle work. Eventually, all the energy used in metabolism is transformed into heat and dissipates in the environment.



Pn – **proizvodi trophic level n**
Rn – **loss on respiration trophic level n**
Fn – **energy losses with faeces on the trophic level n**
In – **energy losses with faeces on the trophic levels n**
Pn-1 – **available to consumption products trophic level n-1**

Figure 22- Energy Flow Diagram

Thus, most of the energy during transition from one trophic level to the next one higher, is getting lost. Approximate losses accounted for about 90%: to every next level is passing no more than 10% of the energy from the previous level. This pattern is seen usually as "**the law of ten percent ".** This way, if the energy value of producer is 1000J, when it enters phytophagous body there only 100 jremained, and in the predator's body only 10 j, and if this predator is eaten by another one, then it remains only 1 j, i.e. 0.1% of calories from vegetarian diet.

However, this strict pattern of energy transition from level to level is not quite real, because the trophic chains of ecosystems intertwine in a complex way, creating trophic networks. However,the final resultis: dispersion and loss of energy, which has to be renewedfor life to exist.

It must not be forgotten about the dead organic matter, which is eaten by a large part of heterotrophs. Among them are saprophagous and saprofits (mushrooms), that using energycontained in the detritus. Therefore, there are two types of trophic chains: **eating out chain**, or grazing, that starting with eating of photosynthetic organisms, and detrital chains ofdecomposition, that starting with the remnants of dead plants, corpses and animals' excrements.

The pasture chains, in turn, combining food chains of predators and food chain of parasites.

The predator's food chain goes from producers to herbivore, eatenby small carnivores, and they serve as food for larger predators, etc. Moving along the predator's chain, animals increase in size and reduce in number. Relatively simple and shortpredator's food chain includes consumers of the second-order:

Grass (producer), rabbit (consumer of the 1st order), Fox (consumer of the 2nd order)

Longer and more complex chain includes consumers of the 5thorder:

Pine, Aphids, ladybugs, Insectivorous birds, predatory birds

The chain elongation occurs through participation of predators in it.

Parasites' food chains, on the contrary, lead to the organisms that are increasingly reducing in size and growing in number. An exampleof it would be:

Grass, Herbivorous mammals, Fleas, Flagellates

The third type of food chains, starting with dead remains of plants, corpses and excrements of animals, and being referred to detrital (saprophytic) food chains or to detritaldecomposition chain. In the detrital food chain of terrestrial plants of ecosystemsdeciduous forestsplay an important role, where most of foliage is not used as food by animals and herbivores and included into litter composition from the fallen leaves. The leaves are chopped by the numerous amount of detritus - fungi, bacteria, insects (e.g., springtail), etc., and then being swallowed by the Earth (rain) worms that carry even distribution of humus in the surface layer of the Earth, creating so-called mull'. At this level, fungi are laying the mycelium. Decomposing microorganisms, that are finishing

the chain, produce the final mineralization of dead organic residues. In General, typical detrital food chains of our forests can be represented as follows:

Dead animal – Falciparous flylarvae –Herbal frog– Ordinary lunches.

The real food chains in the ecosystem are much more complicated, because the animal can eat different types of organisms of the same or different food chains, such as upper trophic level predators. Often, animals feed as by plants so by other animals. Its named as omnivorous. Thus, all three types of food chains always coexist in the ecosystem so that its representatives combinedby the numerous relationships, and together they form the food (trophic) network.

Ecological pyramids

Within each ecosystem, the trophic networks have a well-defined structure that characterized by the nature and number of organisms represented at each level of the various food chains.In order to study the relationship between organisms in an ecosystem and its share of graphic image are usually usednot schemasof food chainsbut ecological pyramids. The ecological pyramids express the trophic structure of an ecosystem in geometrical form. They are constructed in the form of rectangles with the same width, but the length of the rectangle should be proportional to the value of the measured object. From here, we can get the pyramids of quantity, biomass and energy.

Ecological pyramids are reflecting the fundamental characteristicsof any biocenosis when it shows its trophic structure:

- it's height is proportional to the length of the considered food chain, i.e. the number of trophic levels contained.

- it's form, more or less, reflects the efficiency of energy transformation during the transition from one level to another.

The pyramid of numbers shows clear pattern discoveredby Elton: the number of individuals that make up the sequence of links from producers to consumers, has been steadily decreasing. This pattern based, firstly, on the fact that to balance the mass of the larger body requires a lot of small bodies; Secondly, from the lower trophic levels to the highest the energy quantity is being lost (from each the level to the previous only 10% being transferred), and thirdly – the inverse relationship of metabolism by size (the smaller the organism, the more intense metabolism it has, the higher the rate of growth in its numbers and biomass).

However, the pyramidsof number will vary greatly by its form in different ecosystems, so the numbers are better off to be shown in tabular form, but the biomass-in the graphics. It clearly indicates the amount of total living substanceat the given trophic level, for example, in mass units per area unit - g/m^2 or volume- g/m^3 etc.

In the terrestrial ecosystems operates the following Law of biomass pyramids: the total mass of all herbivores, and its mass exceeds the whole biomass chain, varies with the changes in the value of clean production, the relationship of the annual increment ratio, which in regard tothe biomass of the ecosystem is small and fluctuates in forests of different geographical zones from 2 to 6%. And only in the meadow plant communities it can reach 40-55%, and in some cases, like semi-deserts-70-75%.

In Figure 23 showing the biomass pyramids of some biocenosises.

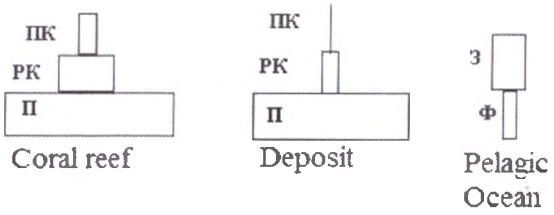


Figure. 23. *An example of biomass pyramid*

As you can see from the picture, for the Ocean, above shown Law of biomass pyramids is invalid- it has an inverted (labeled) form. For the Ocean ecosystem, it is characteristic to have a tendency of biomass accumulation at high levels, at the level of predators. Predators live long and itsturnover and generation rate is low, but in case of producers - phytoplankton algae - turnover may exceed in hundreds times the biomassstock. This means that its pure production here is greater than production absorbed by consumers, i.e. through the level of producers passes more energy than through all the predators.

Hence, it is clear, that even more perfect reflection of the influence of trophic relationships on the ecosystem should be **the lawpyramid'sproduction (or energy)**: on each previous trophic level, the amount of biomass generated per unit of time (or energy), is bigger than on the subsequent one. The Pyramid of production reflects the laws of energy expenditure in the trophic chains.

Let's consider in more detailed what happens with the energy when transfering through the food chain.

Previously, it was noted that the solar energy received by the plants, only partially is used in photosynthesis. Fixed energy in carbohydrates is a gross ecosystem production (RO). Carbohydrates are going to build a protoplasm and plant growth. Part of its energy is spent on breathing (D1). NET production is determined by the formula:

$$\mathbf{NET = Ro - D1}$$

Consequently, the flow of energy passing through the level of producers or gross production, can be submitted as:

$$\mathbf{NET = Ro + D1}$$

A number ofsubstances established by producers serve as food (F) for phytophagous. The rest of them, as a result, die and being processed by reducents (N). Assimilated by phytophagous food (A2) only partially being used for its biomassformation (P2). Mostly, it is being wasted on energy ensuring for the processes of respiration (D2) and to a certain extent is excreted from the body in the form of excreta and excrement (E). The flow of energy that passes through the second trophic level is expressed as follows:

$$\mathbf{A2 = P2 + D2}$$

Consumers of the second order (predators) do not destroy the entire biomass of their victims. Wherein,only part of the destroyed quantity is being used to create the biomass of its own trophic level. The rest is mostly spent on energy of respiration andbeing secreted with the excrements and excreta. Then energy passing through the level of second order consumers (carnivorous), expressed by the formula:

$$\mathbf{A3 = P3 + D3}$$

Similarly, can be traced the totality of the food chain until the last trophic level. The flow of energy expressed through the number of assimilated substances in the food chain at each trophic level decreases or:

$$\mathbf{Pq > P2 > P3, etc.}$$

Lindemann's Law

R. Lindeman in 1942 formulated the first law of theenergies' pyramid, which are often being called in textbooks as "the law of 10%". According to this law, from one trophic level of ecological pyramid goes to anotherlevel, on average, no more than 10% of energy. To the subsequent heterotrophsis passed only 10-20% of the original energy. Using the law energies' pyramid, it is not difficult to calculate that amount of energy amounting to tertiary carnivores (5^{th} trophic level) is about 0.001 energy from one level to another occurs with very low efficiency. This explains the limited number of links in the food chain, regardless of the type of the biocenosis. E. Odum (1959) in extremely simplified chain – alfalfa - calf – childevaluated the conversion of energy, and illustrated the magnitude of its loss. Suppose, he reasoned, there is a seeding of alfalfa in the area of 4 ha. The calves are fed on this field (it is assumed that they eat only alfalfa) and 12-year-old boy eats exclusively veal. The calculation results presented in the form of three pyramids: abundance, biomass and energy (fig. 19) showed that alfalfa uses only 0.24% of the incident solar energy on the field, only 8% of this production is being digested by calf and only 0.7% of the biomass of the calfis providing the child's development throughout the year. (Fig. 24).

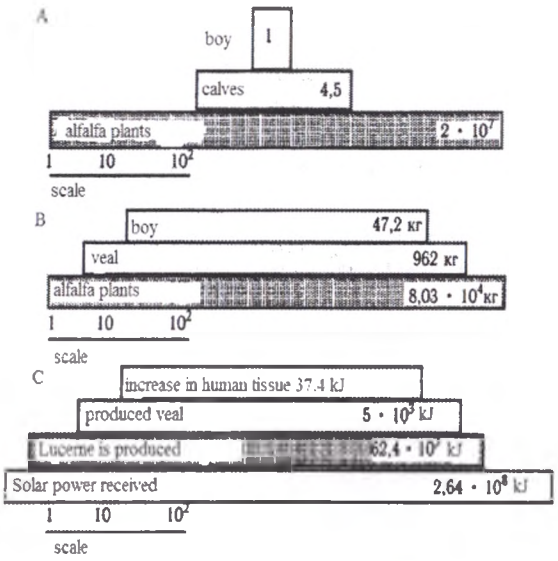


Figure. 24 *- Simple trophic pyramide (y. Odum, 1975)*
A - pyramid of numbers; B-pyramid of biomass;C -pyramid of energies.

E. Odum, this way, illustrated that only one millionthshare of attributable solar energy transformed into biomass of carnivorous, and in this case increases the mass of the child,but the rest is wasted, dissipated in degraded form in the environment. The above example illustrates a very low ecological efficiency of ecosystems and small efficiency when turning into food chains. It can be stated as follows: If 1000 kcal is fixed by producers, then 10 kcal enters the biomass of herbivores and only 1 Kcal – to the biomass of carnivores.

Since a certain amount of a substance can be used by every biocenosi repeatedly, but the energy ratio once, then it is more expedient to say that there is a cascading energy transfer going on in the ecosystem.

Consumers serve as managers and stabilizing factor in the ecosystem.

Consumers are breeding the range of diversity in cenosis, preventing the monopoly of dominants. **The law of consumers' management importance**can be reasonably attributed to the quite fundamental. According to cybernetic beliefs control system should be much more complex in structure than managed system, and the reason of a plurality of underlying cause. The flow of energy through one or the other trophic level cannot absolutely be determined by the availability of food in the underlying trophic level. As known, there is always an adequate supply being leftover, sincethe complete destruction of food would have resulted the death of consumers. These common patterns observed within the borders of population processes, communities, levels of the environmental pyramid, and biocenoses in General.

Ecosystem productivity

Ecosystem productivity is closely linked with the flow of energy through a particular ecosystem. In each ecosystem, portion of incoming energy falling into the food chain, accumulating in the form of organic compounds. The nonstop production of biomass (living matter) is one of the fundamental processes of the biosphere. An organic substance created by producers in the process of photosynthesis or chemosynthesis, called *primary products of the ecosystem* (community).Its quantity expressed in raw or dry mass of plants or in energy units is equivalent to the number of calories or joules. Primary production determines the total energy flow through biotic component of the ecosystem and, therefore, the biomass of living organisms that can exist in the ecosystem (fig. 25).

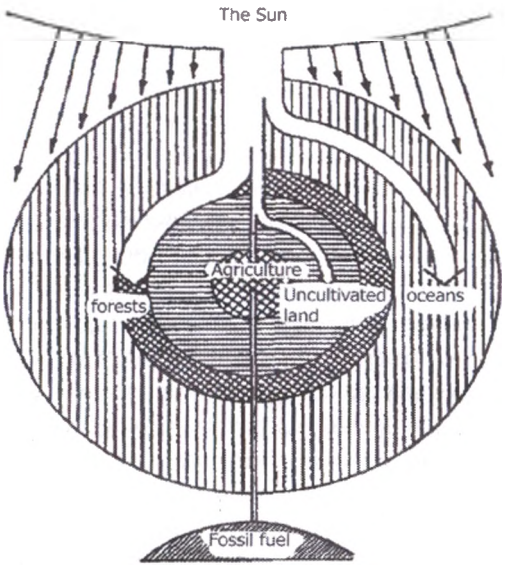


Figure 25 *- primary production of large units Biosphere (byF. Ramada, 1981)*

Note: the intensity of production is proportional to the density of the hatch

Theoretically possible speedof the primary biological production creationis determined by the capabilities of the photosynthetic apparatus of plants. And as we know, only a fraction of the energy of light, received bythe green surface, can be used by plants. Fromthe shortwave Sun radiation only 44% of photosynthetically active radiation refers to (PAR) –light by the wave length, that is suitable for photosynthesis. The maximum achieved efficiency of photosynthesis in nature is 10-12% of the PAR energy, which is about half of a theoretically possible, stated in the jugar and cane thickets in Tajikistan in the short-term, the most favorable periods.

The efficiency of photosynthesis in 5% is considered very high for the phytocenosis. In total, around the globe, the absorption of solar energy plants does not exceed 0.1% because of a limitation of photosynthetic activity of plants by many factors, among them such as lack of heat and moisture, adverse physical and chemical properties of the soil and so on. The average utilization of PAR energy for the territory of Russia is equal to 0.8%, on the European part

of the country is 1.0-1.2%, while in eastern regions, where conditions are less favorable, does not exceed 0.4-0.8%. The rate at which plants accumulate chemical energy, called *gross primary* productivity (GDP). About 20% of this energy is consumed by plants for the| respiration and photorespiration. The rate of organic substance accumulation due to deduction of this consumption called as net primary production(NWP). This is the energy that canbe usedby the organisms of the next trophic level. The amount of organic substance accumulated by heterotrophic organisms, called as*secondary production*.The secondary production is being calculated separately for each trophic level, because the weight gain on each oneoccurs due to the energy coming from the previous. The heterotrophs, joining the trophic chain, eventually live off the net primary production community. The fullness of its flow is varied in different ecosystems. The gradual increase of the total biomass of producers is highlighted, if the withdrawal rate of primary production in the food chains is behindthe plant growthrate.

The world distribution of primary biological production is very uneven. NET products vary from 3000 g/m2/year to zero in the extraarid deserts, deprived of plants, or inconditions of Antarctica with its eternal ice on the surface of the land, and the biomass' stock is from 60 kg/m2 to zero. R. Whittaker (1980) divides all the community's productivity in four class.

1. Communities of higher productivity 3000-2000 g/m2/year. This includes rain forests, crops of rice and sugar cane. The biomass supply in this class of productivity is quite different and exceeds 50 kg/m2 in forest communities and is equal to the annual cropsproductivity.

2. Communities of high productivity, 2000-1000 g/m2/year. This class includesthe deciduousforests, meadows when applying fertilizer, corn crops. The maximum biomass is approaching biomass of the first class. The minimum biomass respectivcly cqual to pure biological production of annual crops.

3. Communities ofmoderate productivity 1000-250 g/m2/year. This classification applies to the bulk of arable crops, shrubs, steppe. The biomass of steppe varies within 0.2-5 kg/m2.

4. Communities of low productivity, below 250 g/m ^ year — deserts, semi-deserts (in the domestic literature it is often referred to steppes), tundra.

Biomass and primary productivity of the major ecosystem types presented in table. 3

Table 3 - **Biomass and primary productivity of the major ecosystem types (by T. D. Akimova, V. V. Haskin, 1994)**

Ecosystems	Biomass, t/ha	Production t/ha per year
Desert	0,1—0,5	0,1—0,5
Central zone of the ocean	0,2—1,5	0,5—2,5
Polar Sea	1—7	3—6
Tundra	1—8	1—4
Steppe	5—12	3—8
Agrocoenosis	—	3—10
Savannah	8—20	4—15
Taiga	70—150	5—10
Deciduous forest	100—250	10—30
Humid tropical forest	500—1500	25—60
Coral Reef	15—50	50—120

On the territory of Kazakhstan in the areas of sufficient moistening, the primary productivity increases from North to South, with an increased flow of heat and duration of the growing season (the season). (fig. 26).

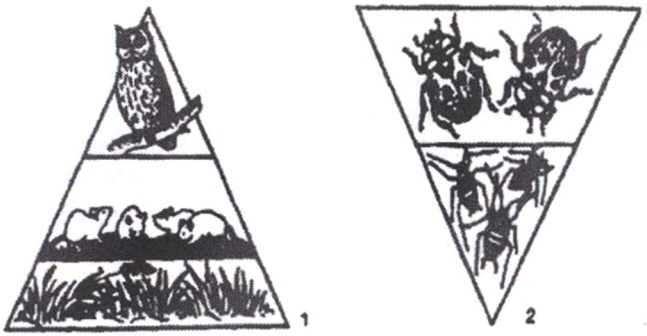


Figure 26 *- Phytomass Reserves (A) the major ecosystems of the IEuropean territory of Russia and the ratio (in %) of phytomass parts (B):*
1- green parts of plants; 2- elevated perennial fattening - lower parts; 3 - the underground part

Total annual productivity of dry organic matter on Earth is 150-200 billion tons.Two thirds of it is formed on the land, the third part is in the ocean.

Virtually all of the net primary production of the Earth is for supporting life of all heterotrophic organisms. The subsoil by consumers, energy, stored in their bodies, soil humus and organic sediments of water bodies. Nutrition of people, for the most part is ensured by crops, occupying about 10% of the land area. The annual increase of cultivated plants is approximately 16% of all productivity of land, most of which falls in the forest.

Half of the harvest goes directly to for people's nutrition, the rest is to feed the pets, used in industry and being lost in the wastes. Human consumes about 0.2% of the primary production land. The resources available on Earth, including animal production and fisheries results both on land and in the ocean, can provide annually, only 50% of the needs of today's population.

Behind the success in global food production is hiding the fact that, since 1950 to 1988 g. latest food production decreased into 43 developing countries (22 African countries), where every seventh inhabitant of the planet lives. The biggest decline is observed in Africa. Here between the 1960 and 1988 yr. the average food production per capita during recalculation fell by 21%. It is anticipated that in the next 25 years, it will decline by further 30%. It is particularly difficult to provide the population with secondary products. Human diet should consist of at least 30 g of protein per day.

Therefore, increasing biological productivity of ecosystems and especially secondary products is one of the major challenges that humanity is facing.

Test tasks for self-control:

Test 1

Who coined the term "ecosystem"?

1. V.n. Sukachev.
2. A. Arthur Tansley.
3. G. Suess.
4. V. I. Vernadsky.
5. E. Haeckel.

Test 2

Biogeocenosis is:

1. the community of living organisms.
2. the community of living organisms adapted to a particular environment conditions.
3. relationship between living and non-living organisms.
4. any ecological system.

5. Evolutionary current, spatially limited, long-term self-sustaining homogeneous natural system, in which functionally interrelated living organisms and their abiotic environment, characterized by relatively independent metabolism and a special type of energy flow that comes from the Sun.

test 3

Sustainability of ecosystems is determined by the ability to:

1. To maintain its structure.
2. Keep functional features.
3. Maintain its structure and functions under the influence of external factors.
4. Unfavorable conditions.
5. Change under the influence of environmental factors.

Test 4

Organisms in the process vital functions convert organic residues into organic substances are called:

1. Producers.
2. Reducents.
3. Consumers
4. Most.
5. The parasites.

test 5

The food chainistend to be no more than 4-5 links. This is due to:

1. Low productivity plants.
2. the disadvantage of forage.
3. Nutrition in strictly determined community views.
4. small species diversity in the natural community.
5. The transformation of energy in the power circuits.

test 6

Under rule ecological pyramid, determine how much of the plankton in the sea grew to dolphin, weighing 400 kg:

1.400 kg.
2.4 t.
3.40 t.
4.4000 tonnes.
4.400 kg.

Test 7

Select the statement with which you disagree.

Food relationship in nature like "predator-prey":

1. Create conditions for the circulation of substances.
2. Regulate number of both species.
3. Create the integrity of ecological systems.
4. Help develop devices to Su-.
5. Must be subject to man.

test 8

Often various types of invertebrate stomach-settling in rodents, finding there an enabling environment and for ourselves without being a master of parasites burrow. This phenomenon is called:

1. Acclimatization.
2. Tetantism.
3. Amensalism.
4. Commensalism.
5. Competition.

test 9

With which provision of the types-parasites don't you agree?

1. Have a great strength in the host organism.
2. Eat prepared organic substances in the body of the host.
3. Have great fertility.
4. Often have complex development cycle.
5. Rarely found in nature.

test 10

Which of the proposed schemes correctly reflects the energy transfer in a food chain?

1. Fox-shrew-earthworm- fallen leaf-plants.
2. fallen leaf-earthworm-plant-shrew-Fox.
3. Plant-fallen leaf -earthworm-shrew-Fox.
4. Plants-shrew-earthworm-fallen leaf -Fox.
5. Earthworm-shrew-Fox-plant-fallen leaf.

THEME 5. DOCTRINE ABOUT THE BIOSPHERE AND NOOSPHERE. BIOSPHERE AND ITS SUSTAINABILITY. THE EVOLUTION OF THE BIOSPHERE

5.1. The basis of biological organization, biogenic elements, bio-resources of the biosphere

5.2. Biosphere and its sustainability. Structure of the biosphere. Coevolution of the atmosphere, lithosphere, hydrosphere, and biosphere

5.3. The evolution of the biosphere, key trends. Pre-biotic and biotic evolution phase of the biosphere

5.4. "Doctrine about the biosphere" as a natural stage in the development of Earth Sciences.

V.I.Vernadskydoctrine about biosphere and noosphere

The biosphere as one of the membranes of the Earth. The composition and boundaries of the biosphere. Properties of the living systems.

To understand the structure and functioning of ecological systems, it would be advisable to formulate the most general properties of living systems in terms of the physical picture of the world. Between living and non-living there is no insurmountable borders. Alive may be called the dynamic system, which actively perceives and transforms the molecular information to self-preservation. The notion of dynamical system defined above. Molecular information is a collection of signals transmitted by specific molecules. The signal of the relative dynamical system is the effect, that is transforming,in a specialway, the functioning of this element. An active perception and transformation of information means an advance (protective) signaling response to external influences and related internal changes in the system. In Biology manual, it is usually defined as thequality of irritability. For perception and transformation of the signal, which provides proactive response, and this response requires the following conditions: the system must possess a structural organization. This assumes heterogeneity, discreteness and structural stability, whichat the same time represents both: the condition and the purpose of the forward reaction. There is a need fora supply of concentrated (non-dissipating) energy that could be used for the perception and the emergence of signals, response to it and preserve the structure.

This energy in living systems enclosed in certain chemical bonds in a set of substances. To release this energy and transformintoconservative

functioning, there are substances needed, that can reduce the potential barriers of chemical reactions — catalysts (its role in the body perform enzymes) and molecules-converters that transform extracted chemical energy into molecular information and operation-chemical (osmosis, active transport of substances, biosynthesis of macromolecules) and mechanical (operation growth, muscle contraction).In the structure of the converters that perform information function, there are being coded the programs of information reading and implementation. There are two kinds of such programs: a) programs of structures' reproduction, the copying biosynthesis (genetic memory); it is coded in the molecular structure of nucleic acids-DNA and RNA; b) the programsof operational signal response – individual behavior (signal memory); those are recorded in the systems of reflex structures, involving sensitive elements and effectors.

Information arises from the interaction with the flow of energy. Since, the signals in a live systemare passed by special molecules, the receivingstructures – receptors must possess a skill of molecular recognition.

It is carried out by a weak nonvalentinteraction and achieved by a combination of spatial configurations (complementarity) of convergent molecules. On the molecular recognition are based important molecular-biological processes: the activity of enzymes, DNA replication, protein biosynthesis, the interaction of antigen-antibody, chemical reception (taste, smell), etc. Every living cell is managed by a molecular computer that performs operations on signaling molecules according to the program, stored on the DNA and RNA. The target function of living system – is self-preservation usingthe proactive response – also defines other fundamental characteristics of life.

With every reaction, every elementary act in the live system isbeing spent a portion of a reserve of energy and energy resources, as well as frame structures. For its resumption and preserving of the integrity,there is a need for the substances inflow of necessary and energy from the environment. These processes are usually indicatingas the substances and energy exchange - metabolism.

In the metabolism, the interconnected processes of assimilation are integrated and balanced, i.e.the substances synthesis, and dissimilation – collapse of complex compounds into simple once with the release of energy.

The gradual accumulation in each living system of irreversible structural changes limits its existence in time. Therefore, the body cell is seeking to replicate itself and reproduction, without expecting the risk for its live. The presence of the reproduction program in the form of DNA and its great stability

in comparison with other structures of the biological system is being a cause of hereditary characteristic.

However, the heredity is not absolute, same as a living system in general, it has variability under the influence of random spontaneous or induced changes in the genetic apparatus – mutations. The inherited changes and its' selection under the influence of environmental factors causing the speciation and increase of biological diversity. It is also can be considered as anticipatory reactions, but already from the point of the ecological systems: ifthe living conditions change, then the species diversity provides greater probability of saving lives with the help of forms, that are relatively better adapted to new conditions. These characteristics define the process of biological evolution.

Levels of biological organization.

Usually, there are distinguished six main levels of organization of living matter, that create the formal hierarchy: molecular, cellular, organismic, population (population-species), ecosystem, biosphere (ecosphere). All the mentioned above basic properties of living systems has been already implemented at the cellular level.However, the fullness of all natural life is presented only in the last two — ecosystem levels (or even only at the ecosphere level), since not one cell, body or type cannot exist without the variety of other cells, organisms, species and, created by them, environment conditions.

The unity and diversity of living systems.

In nature, same as in the physical world, the virtually infinite variety occurs through a combination of a few elements. The composition of living organisms is composed of the same chemical elementsas the objects of inanimate nature, but its quantity proportion varies. Only six elements - carbon, oxygen, hydrogen, nitrogen, sulfur and phosphorus – accounts for an average of nearly 99% of all living creatures, from viruses to humans. These elements are called biogenic.

Its connections form a few dozensof natural bio-monomers (amino acids, fatty acids, nucleotides, sugars) and other organic substances, various combinations, which, in turn, give the enormous number of individual biopolymers.

Common laws of biosphere organization.

The biosphere is formed, more or less, not by external factors, but by internal patterns. The most important characteristic of the biosphere is the interaction of the living and non-living, which is reflected in the law of the biogenic migration of atoms by V.I. Vernadsky.

The law of biogenic migration of atoms makes it possible for mankind to consciously manage biogeochemical processes, generally, an on Earth so in its regions.

The amount of living matter in the biosphere, as is known, is not subject to significant changes. This law was formulated in the form of *the law of the quantity constancy of living matter by VI Vernadsky*: the amount of living matter of the biosphere for a given geological period is a constant. Practically, this law is a quantitative consequence of the law of internal dynamic equilibrium for a global ecosystem - the biosphere. Since a living substance, in accordance with the law of biogenic migration of atoms, is an energy intermediary between the Sun and the Earth, then either its quantity should be constant, or its energy characteristics must change. The law of physico-chemical unity of living matter (all living matter of the Earth physically-chemically unified) excludes the significant changes in the latter characteristic. Hence, the quantitative stability is inevitable for the living matter of the planet. It is fully characteristic for several species.

A living substance as a solar energy battery must simultaneously react to both - external (cosmic) influences, and internal changes. The reducing or increasing the amount of living matter in one place in the biosphere should lead to the process of the exact opposite result in another place, because the released biogenes can be assimilated by the rest of the living matter or will be observed its lack. Here, we must take into account the speed of the process, in the case of anthropogenic change being much lower than the direct violation of nature by man.

In addition to the constancy and permanency of the amount of living matter, reflected in *the law of the physico-chemical unity of living* matter, the information and somatic structure is constantly preserved in living nature, despite the fact that it changes somewhat with the course of evolution. This characteristic was noted by J. Goldsmith (1981) and was called as*the law of conservation of the biosphere structure* - information and somatic, or *the first law of eco-dynamics*.

To preserve the structure of the biosphere, the living one strives to achieve a state of maturity or ecological balance. *The law of aspiration for climax - the second law of the eco-dynamics of J. Goldsmith*, refers to the biosphere and other levels of ecological systems, although there is a specificity - the biosphere is more enclosed system than its subdivisions. The unity of living matter of the biosphere and the homology of its subsystems' structure leading to the fact that there is a complex intertwine of the living elements

evolving on it of different geological ages and initial geographic origin. Interlacing of different spatially-temporal genesis of elements in all ecological levels of the biosphere reflects *the law* or *the principle of heterogenesis of living matter*. Thissum is not chaotic, but is subordinated to the principles of ecological additionality (complementarity), ecological conformity (congruence) and other laws. In the framework of J. Goldsmith's eco-dynamics, this is its third law - the principle of ecological order, or ecological mutualism, indicating a global characteristic caused by the influence of the integer on its part, the inverse effect of differentiated parts on the development of the integer, etc., which in sum leads to conservation of the biosphere stability in general.

Mutual assistance within the framework of ecological order, or systemic mutualism, is affirmed by the *orderliness law of spaceplenum and spatial-temporal certainty*: the plenum of space within the natural system due to the interaction between its subsystems is arranged in such a way that it allows the homeostatic properties of the system to be realized with minimal contradictions between parts inside of it. From this law follows the impossibility of a long existence of "unnecessary" for the nature of randomness, including those alien to it - created by man. Among the rules of the mutually systemic order in the biosphere is the *principle of system complementarity*, which states that subsystems of one natural system in its development provide the prerequisite for the successful development and self-regulation of other subsystems that are part of the same system.

J. Goldsmith's law of *self-control and self-regulation* is related to the fourth law of eco-dynamics: living systems and systems under the regulatory influence of the living things are capable of self-control and self-regulation in the process of their adaptation to changes in the environment. In the biosphere, self-control and self-regulation occur in the course of cascading and chain processes of general interaction-in the course of the struggle for the existence of natural selection (in the broadest sense of this concept), the adaptation of systems and subsystems, broad co-evolution, etc. At the same time, all these processes lead to the positive "from the point of nature view" results - conservation and development of the biosphere ecosystems andas its whole.

The link between generalizations of structural and evolutionary nature is the *rule of automatic maintenance of the global habitat*: living matter in the course of self-regulation and interaction with abiotic factors autodinamically supports the living environment, that is suitable for its development. This process is limited to changes in the cosmic and terrestrial ecosphere scale and occurs in all ecosystems and biosystems of the planet, as a cascade of self-

regulation reaching a global scale. The rule of automatic maintenance of the global habitat follows from V.I. Vernadsky's biogeochemical principles, the rules of conservation of species habitat, relatively internal consistency and serves as a constant for the presence in the biosphere of conservative mechanisms and at the same time as the confirmation of the rule of system-dynamic complementarity.

The cosmic impact on the biosphere is evidenced by *the law of refraction of cosmic influences*: cosmic factors, influencing the biosphere and especially its subdivisions, are subject to change on the point of the planet's ecosphere, and therefore, by force and time, manifestations can be weakened and shifted or even completely lose its effect. The generalization here is important because often there is a flow of synchronized action of solar activity and other cosmic factors on the Earth's ecosystems and the organisms that inhabit it (Fig. 27).

It should be noted that many processes on the Earth and in its biosphere, although subject to the influence of space, and there are cycles of solar activity expected with the intervals of 1850, 600,400, 178, 169,88,83,33,22,16,11,5 (11,1), 6.5 and 4.3 years, the biosphere itself and its divisions do not necessarily have to react with the same cyclicity in all cases. The cosmic impacts of the biosphere system can block fully or partially.

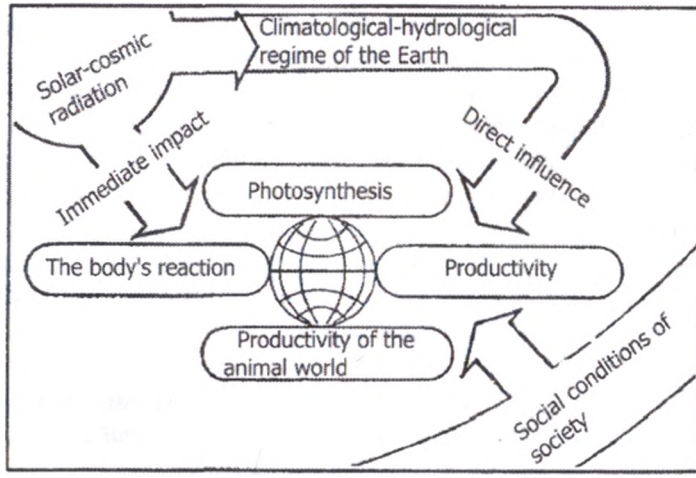


***Figure 27** - Path of outer influence on the biosphere*

Evolution of the biosphere

According to modern science, the age of the Earth is estimated at 4.6 billion years, and the *first signs of life appeared on it, according to paleontology, about 3.5-3.8 billion years ago.* ***The first living organisms were heterotrophs***, which used abiogenic organic molecules for its vital functions. However, over time, there was a decrease in the concentration of free organic matter in the environment, and the advantage was obtained by organisms that acquired the ability to synthesize organic compounds from inorganic compounds. This way***2-3 billion years ago, the first photosynthetic cells of the cyanobacterial type has appeared***, capable of using light energy for the synthesis of organic compounds from CO_2 and H_2O. Distinguishing O_2, the autotrophs were changing the composition of the atmosphere, after this it began to acquire an oxidizing character. Thus, the life that arose on Earth had changed the conditions that made this life possible, in particular, an atmosphere of restorative type, containing methane, ammonia, hydrogen sulphide and other substances.

With the increase of the oxygen content in the atmosphere, *a sufficiently powerful ozone shell (layer) was formed,* which protected the Earth's surface from the penetration of hard cosmic, including ultraviolet radiation. *This has created the opportunity for life to be spread in the thickness of the ocean to its surface and the subsequent release of living organisms to land.* ***During the Paleozoic era*** (beginning - 570 ± 20 million years, the end - 340 ± 10 million years ago) ***life, filled in all the seas, and came out to the dry land***. There was an intensive evolution of higher plants represented in the Paleozoic by almost all groups of spore and gymnosperms. *In the Paleozoic, the main types and classes of invertebrates, as well as vertebrates, excluding birds and mammals, were formed.* If the first half of the Paleozoic is characterized by the predominance of water, mainly marine invertebrates, the appearance of fish-like and fish, the prevalence of different algae, then for the second half - the development of land by plants and animals (invertebrates, amphibians and reptiles).

The evolution of the biosphere was carried out throughout most of its history under the influence of ***two main factors: 1) natural geological and climatic changes on the planet; 2) changes in the species composition and number of living creatures in the process of biological evolution.*** *In the tertiary period of the Cenozoic era, was added****the third (modern) factor - human society****. Accordingly,* ***the stage of biogenesis in the evolution of the biosphere was replaced by the stage of noogenesis****.*

In the evolution of the biosphere, the following main trends can be highlighted:

1) *gradual increase in its total mass and productivity*;

2) *progressive accumulation of accumulated solar energy in the surface shells of the Earth;*

3) *an increase in the information capacity of the biosphere*, manifested in the growing diversification (growth of diversity) of organic forms, the increase in the number of geochemical barriers and the increasing differentiation of the physico-geographical structure of the biosphere;

4) *the enhancement of certain biogeochemical functions of living matter and the emergence of new functions;*

5) *strengthening the transforming influence of life on the atmosphere, hydrosphere and lithosphere,* increasing the role of living matter and its livehoods' products in geological, geochemical and physical-geographical processes;

6) *widening the scope of the biotic cycle and complicating its structure;*

7) *the ever-increasing transformative impact of human activity.* If in the evolution of living matter there is a continuous flow of genetic information and in the human genome there are genes from a whole series of its ancestors, then in the biosphere there are species of different geological ages - "ecogenous elements", or "bioelements" of ecosystems. There is an evolutionary replacement of these bioelements, in the regional framework, sometimes a complete replacement, including the disappearance of predecessors.

Mass extermination of species by human could not but change natural processes. For example, the Pliocene disappearance of large animals apparently occurred not only as a result of direct harassment, but also because of the disturbance of the food chains, which led to the transformation of ecosystems as a whole. Modern destruction of species is happening much faster than in the days of the Pliocene overarm, and leads to processes that result in a decrease of the biomass, productivity and information content of the biosphere, the nature of the accumulation of solar energy in the surface shells of the Earth is changing its character, and so on.

The pre-biotic and biotic phases of evolution

Pre-biotic evolution– chemical evolution has prepared substrates, constructs and reactions for the origin of life, included 4 sub-stages:

1. Formation of the planet and its atmosphere (about 4.5 billion years ago).

2. The emergence of abiotic circulation of substances in the atmosphere.

3. Formation of complex organic substances, biopolymers - proteins, nucleic acids, fatty acids, polysaccharides.

4. The emergence of the cycle of organic compounds of carbon.

Biotic evolution - the evolution of life, included 4 sub-stages:

1. The origin of life (about 3.5 milliards years ago)

2. The appearance of photoautotrophic cells, the development of photosynthesis and the bioproduction of oxygen - a gradual transition to an oxidizing atmosphere.

3. Increase in biological diversity and complexity of the structure and functional organization of living beings and the biosphere in general.

4. Appearance of man - the leader of the evolution.

The development of the biosphere according to the ideas of N.N. Moiseyev –is a chain of disasters with unpredictable outcomes. One such catastrophe was the destruction of the prokaryotic biosphere and its replacement by a biosphere dominated by eukaryotes. A complete reorganization of the biosphere occurred also when the living matter emerged from the ocean. The death of dinosaurs should also be attributed to the number of similar catastrophes. Finally, the appearance of man is also a catastrophe, which brought the mind into the number of mechanisms of the biosphere development, and again with an unpredictable outcome. As a result of the human appearance, the evolution of the biosphere took a completely different path.

The stages of biotic evolution were:

- the complication and improvement of the components of the biotic cycle - the formation of the biosphere, the emergence of multiplying living beings, the biogenic migration of atoms as an expression of life activity;

- the emergence of multicellular organisms and further complicating of the biosphere biotic cycle;

- the differentiation of the living beings, expressed, on the one hand, in increasing of the forms diversity, on the other - in the complication of the structure (what has become known as morphophysiological progress).

During the period of social evolution, the formation and development of human society took place. The labor activity of people becomes a factor of the evolution of the biosphere. The biosphere turns into a unity of abiotic, biotic and social; goes into a new state - into the noosphere.

The chemical synthesis on the emerging Earth should depend on such natural sources of energy as ultraviolet and thermal radiation from the sun, lightning, volcanic heat and radioactivity.

Vernadsky's doctrine of the biosphere and noosphere

The doctrine of the biosphere and the noosphere developed as a result of V.I. Vernadsky profound analysis of all phenomena of life in its' mutual connection between themselves and the inert matter of the planet along the entire path of its' historical development.

The academician - Vladimir Ivanovich Vernadsky is a great Russian scientist, naturalist and thinker, creator of new scientific disciplines, the doctrine of the biosphere, the doctrine of the biosphere transition to the noosphere. The name of V.I. Vernadsky is associated with the entry into science of revolutionary scientific ideas, far ahead of its time and served as the basis for the fruitful development in our days.

In 1945, shortly before his death, this largest scientist made an outstanding contribution to the development of the modern picture of the world. In those years, his ideas about the transformation of the Earth's biosphere into a consciously organized and man-driven noosphere were not appreciated. But over time, when the predicted phenomena began to increase with dizzying speed, the importance of the doctrine of the noosphere, the organic unity of nature and society, that in the conditions of the increased technological power of people, nature can no longer exist and develop without conscious control of its life by humanity, it became obvious. The concept of the biosphere - the noosphere represents the result of all scientific creativity of the scientist, his worldview. It serves as the scientific foundation for the development of a number of modern global problems, and above all, the problems of the human environment and the wise use of the natural resources of the biosphere. A special value for philosophy represents the result of the great work of VI. Vernadsky on the ratio of the forms of motion matter. The doctrine of the biosphere and the noosphere reflects his thoughts about the effect of the higher form of the matter movement on the lower, about the subordination of the lower forms to the more developed. The forms of motion of matter, according to V.I. Vernadsky, are inextricably linked with space, time, and impose its imprint on these fundamental conditions of being.

Thanks to the works of V.I. Vernadsky and further studies of the questions he posed, today, every scientist, armed with geochemical and cosmochemical knowledge, sees the evolution of the Earth and the Cosmos as a historical process of development that encompasses all the phenomena of animate and inanimate nature in interrelation. When they are examined

together, a special position of the natural scientist arises regarding the development of the phenomena of life.

V.I. Vernadsky gave the world a peculiar philosophical direction of universal significance: active evolutionary, noospheric, cosmic thought

TI have chosen this topic is due to the fact that I was interested in the ongoing restructuring of the world picture, which really responds to the changes happening in the world. V.I. Vernadsky, while developing the doctrine of the biosphere, gave to the notion of the noosphere a deeply scientific content that must be taken into account in the process of restructuring the environment and society. In this respect, the noosphere should be regarded as the highest stage of the development of the biosphere, associated with the development of the human society in it, which, knowing the laws of nature and evolvement, and developing the technology to the highest level of its capabilities, becomes a large planetary force exceeding with its scale all the known geological processes laid end to end. At the same time, mankind has a decisive influence on the course of all processes in the biosphere, profoundly changing it with its own labor. The scientific and practical significance of VI. Vernadsky activity - the founder of the doctrine of the biosphere, lays in the fact that he, for the first time, in his entirety of knowledge, deeply substantiated the unity of man and the biosphere. The living matter itself as the carrier of the mind is a small part of the biosphere by weight. The emergence of man and human society was the result of living matter within the biosphere.

Assessing the role of the human mind and scientific thought as a planetary phenomenon V.I. Vernadsky came by with to the following conclusions:

1. "The course of scientific creativity is that force, by which a human changes the biosphere he lives in.

2. This manifestation of the change in the biosphere is an inevitable phenomenon accompanying by the growth of scientific thought.

3. This change in the biosphere occurs independently of the human will, spontaneously, as a natural matter-of-course process.

4. And since the environment of life is an organized shell of the planet - the biosphere, then the occurrence,in the course ofits geologically long existence, of a new factor of its change – the scientific work of mankind - is a natural process of the biosphere transition to a new phase, into a new state - the noosphere.

5. In the historical moment we are experiencing, we see it more clearly than we could have seen before. Here, we discover the "law of nature". New sciences - geochemistry and biochemistry - provide an opportunity to express some important features of the process mathematically.

Test tasks for self-control:

1. Geological Land shell

a) lithosphere, hydrosphere, atmosphere

b) ecosystem agrocenosis, lithosphere

in the tundra, Lakes) soil

g) biogeocenosis, hydrosphere, agro-

2. The lithosphere is

a) solid shell of the Earth

b) gas shell

c) noosphere

d) ecosystem

3. the lithosphere does not apply

a) sedimentary rocks

b) granite

c) basalt

d) agrocenosis

4. Hydrosphere is

a) aerial shell of the Earth

b) agro-

c) water Land shell

d) sedimentary rocks

5. the hydrosphere includes

a) gas shell of the Earth

b) solid shell of the Earth

c) shell lands, inhabited

d) the sum of all the reservoirs of the planet

6. The atmosphere is

a) aerial shell of the Earth

b) water Land shell

c) the troposphere
d) stratosphere

7. The atmosphere
a) ionosphere, troposphere
b) troposphere, stratosphere
c) the stratosphere, ionosphere
d) ionosphere, troposphere, stratosphere

8. The lower part of the atmosphere is
a) hydrosphere
b) lithosphere
c) troposphere
d) ionosphere

9. The layer of the atmosphere containing ozone screen
a) stratosphere
b) ionosphere
c) the atmosphere
d) troposphere

10. The layer, that can absorb and reflect harmful space radiation, is called

a) photosythetic
b) hemosynthetic
c) ionosphere
d) ozone screen

11. "ozone hole" is
a) decreasing the density of the ozone layer
b) ionized atoms
c) aerial shell of the Earth
d) layer of diluted gases

12. The value of ozone holes

a) expose harmful space radiation

b) contribute to the penetration of ultraviolet rays,used for the synthesis of vitamin c) contribute to the greenhouse effect

d) provide a receipt of the ultraviolet rays needed for photosynthesis

13. The ionosphere is

a) layer, located at an altitude of over 15 km, contains various gases

b) layer, located at an altitude of over 200 km, contains ionized atoms

c) layer containing ozone

d) layer containing sparse gases and ionized atoms

14. Special shell of the Earth, formed by living organisms is called

a) hydrosphere

b) biosphere

c) atmosphere

d) lithosphere

15. Who gave a definition of the biosphere

a) A.I. Oparin in 1924 year

b) T. Schwann in 1939 year

c) T. Morgan in 1954 year

d) E. Suess v1875 year

THEME 6. THE CONCEPT OF LIVING MATTER. THE MODERN BIOSPHERE

6.1. The modern biosphere. The concept and functions of living matter in the biosphere

6.2. Distribution of living matter in the biosphere. Limits of the biosphere. Man in terms of the laws of evolution

6.3. Ecology of man. Ecological niches of man

6.4. The coevolutionary character of the development of society and nature at the present stage of development of society and nature

The biosphere as one of the shells of the Earth

The **biosphere** (from Greek βίος*bíos* "life" and σφαῖρα*sphaira* "sphere") the complex outer shell of the Earth, populated by organisms that make up the living matter of the planet. This is one of the most important geospheres of the Earth, which is the main component of the natural environment that surrounds man.

At the level of ecosystems of the elementary plan, the principle of local actions must be implemented, while the biosphere level forms the basis for global thinking.

At the present time it becomes extremely clear that the environment in which we live is formed by living organisms of different geological epochs. In the manner of B. Commoner, the environment is "... this is a house created on Earth by life and for life". At the same time, each generation of organisms perfected the house according to the changing conditions and the creature living in it. These truths became understandable to people far from immediately. The most important contribution to this section of modern ecology was made by the researches of Academician VI Vernadsky (1863-1945), his teaching on the biosphere.

The concept of the Biosphere

The term "biosphere" was coined by geologist Eduard Suess in 1875, which he defined as the place on Earth's surface where life dwells.

VI Vernadsky (1863-1945) used this term and created a science with a similar name. If the concept of "biosphere", according to Süss, was associated only with the presence in three spheres of the earth's shell (solid, liquid and

gaseous) living organisms, then, according to Vernadsky, they are assigned the role of the main geochemical force. At the same time, the concept of the biosphere includes the transforming activity of organisms not only within the boundaries of the spread of life at the present time, but also in the past. In this case, the biosphere is understood as the whole space (the shell of the Earth), where life exists or has ever existed, that is, where living organisms or products of their vital activity meet.

The part of the biosphere where living organisms are found today is usually called the modern biosphere, or neo-isosphere, and the ancient biospheres are referred to as paleobiospheres, or white biospheres. Examples of the latter can be called lifeless accumulations of organic substances (deposits of hard coal, oil, oil shale, etc.) or stocks of other compounds formed with the participation of living organisms (lime, chalk, compounds).

According to the latest data, the earth's mass is 6 * 1021 tons, its volume is 1,083 * 1012 km3, the surface area is 510.2 million km2. Dimensions, and, consequently, all natural resources of our planet are limited. (Figure 28)

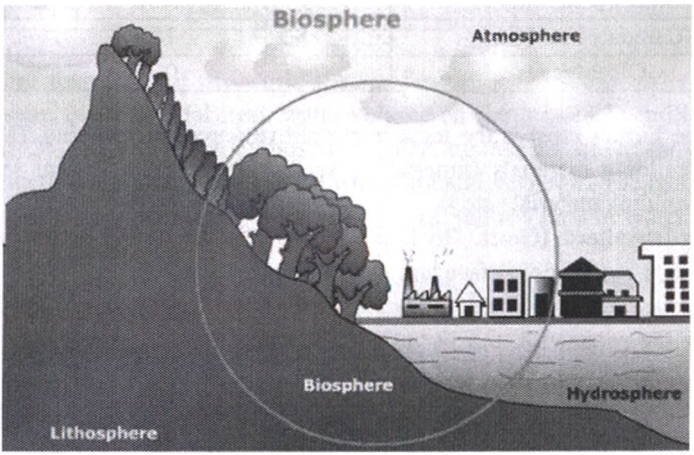


Fig. 28. *Borders of the biosphere*

Our planet has a heterogeneous structure and consists of concentric shells (geospheres) - internal and external. The core includes the core, the mantle, and to the outer - the lithosphere (the earth's crust), the hydrosphere, the atmosphere and the complex shell of the earth - the biosphere.

Lithosphere (Greek "lithos." - Stone) - stone shell of the Earth, including the crust capacity (thickness) of 6 (under the ocean) to 80 km (mountain ranges). The earth's crust is composed of rocks. The share of various rocks in the earth's crust is not the same - more than 70% is found in basalts, granites and other magmatic rocks, about 17% in pressure and high temperature rocks and only slightly more than 12% in sedimentary rocks (Table 4).

Table 4- **Ratio of rocks of the earth's crust**

Name of rocks	Percentage of total volume of the cortex,%
Magmatic and metamorphic rocks	
Granites, diorites, effusites	20.86
Crystalline schists, gneisses	16.91
Basalt, gabbro, amphiboles	50.34
Sedimentary rocks	
Clays and shales	4.48
Sands and sandstones	3.56
Carbonaceous rocks	3.57
Other breeds	0.28

The Earth's crust is the most important resource for mankind. (Minerals, natural building materials (limestones, sands, gravel, etc.) Natural resources, natural building materials etc.).

Hydrosphere (Greek "hydora" - water) is the water envelope of the Earth. It is divided into surface and underground.

Surface hydrosphere is the water shell of the surface part of the Earth. It includes the waters of the oceans, seas, lakes, rivers, reservoirs, marshes, glaciers, snow cover, etc.

Surface hydrosphere does not form a continuous layer and intermittently covers the earth's surface by 70.8%.

Underground hydrosphere - includes waters that are in the upper part of the earth's crust. They are called underground. Above, the underground hydrosphere is bounded by the surface of the earth, its lower boundary can not be traced, since the hydrosphere penetrates very deeply into the earth's crust.

In relation to the volume of the globe, the total volume of the hydrosphere does not exceed 0.13%. The main part of the hydrosphere (96.53%) is the World Ocean (Table 5). The share of groundwater is 23.4 million km2, or 1. 69% of the total hydrosphere, the rest - the water of rivers, lakes and glaciers.

Table 5.-Distribution of water on Earth

Parts of hydrosphere	Area of distribution, thousand km^2	Water volume, Thousand km^2	Share of total world water reserves,%
World Ocean	361300	1138500	96.53
Glaciers and snow (polar and mountainous areas)	16227	24064	1.74
The groundwater	134800	23400	1.69
Underground ice in the permafrost zone	21000	300	0.023
Lakes	2058	176	0.014
Soil Moisture	82000	16.5	0.001
Atmosphere pairs	5,100.000	12.9	0.001
Marshes	2682	11.4	0.0007
River water	148800	2.1	0.0002

More than 98% of the world's water resources are saline waters of the oceans, seas, etc. The total fresh water volume on Earth is 28.25 million km3, or about 2% of the total hydrosphere. The main part of fresh water is concentrated in glaciers, the waters of which are still very few. The rest of fresh water, suitable for water supply, accounts for 4.2 million km3 of water, or only 0.3% of the hydrosphere.

The hydrosphere plays a huge role in shaping the natural environment of our planet. Very actively, it affects the atmospheric processes (heating and cooling of air masses, saturation with moisture, etc.).

Atmosphere (Greek "atmosphere" - steam) - the gas shell of the Earth, consisting of a mixture of various gases, water vapor and dust (Table 7 by N. Reimers, 1990). The total mass of the atmosphere is -5.15 * 1015 tons. At an altitude of 10 to 50 km, with a maximum concentration at an altitude of 20-25 km, there is an ozone layer protecting the Earth from excessive ultraviolet irradiation, fatal to organisms.

Table 6 - **Composition of the atmosphere**

Elements and gases	Content in the lower atmosphere,%	
	By volume	By weight
Nitrogen	78,084	75.5
Oxygen	20.964	23.14
Argon	0.934	1.28
Neon	0,0018	0,0012
Helium	0.000524	0,00007
Krypton	0,000114	0.0003
Hydrogen	0,00005	0,000005
Carbon dioxide	0.034	0.0466
Water vapor: In the polar latitudes At the equator	0.2 2.6	- -
Ozone: In the troposphere In the stratosphere	0,000001 0.001 - 0.0001	--
Methane	0.00016	0.0009
Nitric oxide	0,000001	0.0000003
Carbon monoxide	0.000008	0.0000078

The atmosphere physically, chemically and mechanically affects the lithosphere, regulating the distribution of heat and moisture. Weather and climate on Earth depend on the distribution of heat, pressure and water vapor content in the atmosphere. Water vapor absorbs solar radiation, increases the density of air and is the source of all precipitation. The atmosphere supports various forms of life on Earth.

In the formation of the natural environment of the Earth, the troposphere (the lower layer of the atmosphere to a height of 8-10 km in polar, 10-12 km in temperate and 16-18 km in tropical latitudes) and to a lesser extent the stratosphere, the region of cold rarefied dry air of about 20 km. Through the stratosphere meteorite dust is continuously falling, volcanic dust is thrown in it, and in the past, products of nuclear explosions in the atmosphere.

In the troposphere, there are global vertical and horizontal movements of air masses, which in many cases determine the water cycle, heat exchange, transboundary transport of dust particles and pollution.

Atmospheric processes are closely related to the processes taking place in the lithosphere and the water shell

To atmospheric phenomena include: precipitation, clouds, fog, thunder, ice, dust storm, squall, snowstorm, frost, dew, hoarfrost, icing, aurora, etc.

The biosphere is the outer shell of the Earth, which includes part of the atmosphere up to an altitude of 25-30 km (up to the ozone layer), practically the entire hydrosphere and the upper part of the lithosphere to about 3 km.

The peculiarity of these parts is that, they are inhabited by living organisms that make up living matter of the planet. The interaction of the abiotic part of the biosphere - air, water and rocks and organic matter - biota caused the formation of soils and sedimentary rocks. The latter, according to VI Vernadsky, bear the traces of the activity of the ancient biospheres that existed in the past geological epochs.

According to VI Vernadsky, the matter of the biosphere consists of:

- living matter - biomass of modern living organisms;
- biogenic matter - all forms of detritus, as well as peat, coal, oil and gas of biogenic origin;
- detritus - a dead organic matter in an ecosystem of cumulatively suspended and sedimented organic mineral particles
- a biocidal substance - mixtures of nutrients with minerals of non-biogenic origin (soil or natural waters, gas and oil shales, bituminous sands, part of sedimentary carbonates;
- inert substance - rocks, minerals, sediments, not affected by direct biogeochemical exposure of organisms.

According to data based on the content of energy or carbon, the amount of living, biogenic and bio-nutrient in the biosphere is related as 1: 20: 4000

According to data based on the content of energy or carbon, the amount of living, biogenic and bio-nutrient in the biosphere is related as 1: 20: 4000

Composition and boundaries of the biosphere

The biosphere, being a global ecosystem, like any ecosystem, consists of an abiotic and a biotic part.

The abiotic part is represented by: 1) the soil and the underlying rocks to the depth, where they still have living organisms that have entered into an exchange with the matter of these rocks and the physical environment of the pore space;

2) atmospheric air to the altitude, on which there are still possible manifestations of life; 3) the aquatic environment of oceans, rivers, lakes, etc.

The biotic part consists of living organisms of all taxa that carry out the most important function of the biosphere, without which life itself can not exist: the biogenic current of atoms. Living organisms carry this current of atoms due

to their breathing, feeding and reproduction, ensuring the exchange of matter between all parts of the biosphere (Figure 33)

At the heart of the biogenic migration of atoms in the biosphere are two biochemical principles:

- to strive for maximum manifestation, for "universal" life;
- to ensure the survival of organisms, which increases the biogenic migration itself.

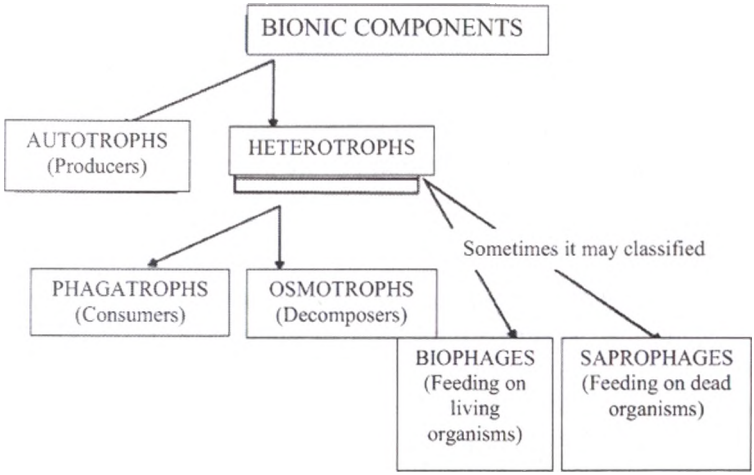


Figure *29* - *Interrelation with the components of the biosphere*

With a general examination of the biosphere as a planetary ecosystem, the idea of it's living matter as a certain living mass of the planet acquires special significance.

Under the living matter of V. I. Vernadsky realizes all the number of living organisms of the planet as a whole. Its chemical composition confirms the unity of nature - it consists of the same elements as inanimate nature, only the ratio of these elements is different and the structure of the molecules is different.

Living matter forms an infinitesimally thin layer in the total mass of Earth's geospheres - 3 mm.

According to scientists, its mass is 2420 billion tons, which is more than two thousand times less than the weight of the lightest shell of the Earth - the atmosphere.

But this insignificant mass of living matter is found almost everywhere - currently living beings are absent only in the region of extensive glaciation and in the craters of active volcanoes. (Appendix Ratio of chemical elements in living matter, hydrosphere, lithosphere and in the mass of the Earth as a whole)

The main unique features of living matter, which determine its extremely high environment-forming activity, include the following:

1. *The ability to quickly take up (absorb) all free space.*V. I. Vernadsky called it the life of the whole life. This property gave grounds to VI Vernadsky to conclude that for certain geological periods the amount of living matter was approximately constant (constant). The ability to quickly master the space is associated with both intense breeding (some of the simplest forms of organisms could have mastered the entire globe in a few hours or days, if there were no factors holding back their potential breeding capacity), or with the ability of organisms to intensively increase the surface of their body or Formed by them communities. For example, the area of leaves of plants growing per hectare is 8-10 hectares or more. The same applies to root systems.

2. *Movement not only passive (under the effect of gravity, the gravitational forces and the like), but also active.* For example, against the flow of water, gravity, movement of air currents, etc.

3. *Stability at life and rapid decomposition after death* (inclusion cycles), while retaining high physical and chemical activity.

4. *High adaptive capacity* (adaptation) to different conditions and in connection with the development of not only all life environments (water, land, air, soil, organism), but also extremely difficult physical and chemical parameters of environment. For example, some organisms tolerate temperatures close to absolute zero values of -2730C, microorganisms occur in thermal springs with temperatures up to 1400C, in the waters of nuclear reactors, in anoxic environment, in ice shells, etc.

5. *phenomenally high reaction rate.* It is several orders of magnitude (hundreds, thousands of times) more significant than in non-living matter. This property can be judged by the rate of processing of matter by organisms in the process of vital activity. For example, the caterpillars of some insects consume per day the amount of food that is 100-200 times the weight of their body. Particularly active organisms are soil creatures. Earthworms (the mass of their bodies is about 10 times larger than the biomass of the entire mankind) for 150-200 years pass through their organisms the entire one-meter layer of soil. The same phenomena occur in the bottom sediments of the ocean. The layer of bottom sediments here can be represented by the products of life of ringed

worms (polytech) and reach several meters. An enormous role in the transformation of matter is carried out by organisms, for which a filtration type of food is characteristic. They release water masses from suspensions, gluing them into small aggregates and depositing the bottom.

Impressive examples of purely mechanical activity of some organisms, for example, burrowing animals (marmots, ground squirrels, etc.), which as a result of processing large masses of soil create a peculiar landscape. According to VI Vernadsky's ideas, practically all sedimentary rocks, and this layer up to 3 km. are 95-99% processed by living organisms. Even such colossal reserves of water that exist in the biosphere are decomposed during photosynthesis in 5-6 million years, carbon dioxide passes through living organisms in the process of photosynthesis every 6-7 years.

6. *The high update rate of living matter.* It is estimated that the average for the biosphere is 8 years, with land for 14 years, and for the ocean, where organisms with a short life span (for example, plankton) predominate, 33 days. As a result of the high rate of renewal in the whole history of existence of life, the total mass of living matter that has passed through the birches of the biosphere is approximately 12 times the mass of the earth. Only a small part of it (a fraction of a percent) is conserved in the form of organic residues (in the words of VI Vernadsky, "went into geology"), the rest was involved in the processes of the cycle.

All of these and other properties of living matter are due to the concentration in it of large energy reserves. According to VIVernadsky, only lava formed during volcanic eruptions can compete with energy saturation with living matter.

The mediating functions of living matter. All the activities of living organisms in the biosphere can, with a certain degree of conventionality, be reduced to several fundamental functions that allow us to significantly supplement the notion of their transforming biospheric-geological role. Geochemical cycles and cycling generally provide important *functions of living matter* in the biosphere. In and Vernadsky singles out 9 such functions, of which 5 are basic:

-first function – gas - basic gases Earth's atmosphere, nitrogen and oxygen, biogenic origin, like all underground gases - a product of decomposition of dead organic matter;

- *the second function – concentration* - organisms accumulates in their bodies, many chemical elements, among which the first place is carbon, metals

among - a first calcium, silicon concentrators are diatoms, iodine - seaweed (kelp), phosphorus - skeletons vertebrates;

- *the third function – redox* - organisms living in waters, controlled oxygen conditions and create the conditions for deposition or dissolution of a number of metals and non-metals with variable valency;

- *the fourth function - biochemical* - reproduction, growth and movement in space ("spread") the living matter;

- *fifth function - biogeochemical human activities* - all spans expands number crust substances, including concentrates of carbon, such as coal, oil, gas, etc., for commercial and domestic human needs..

The biogeochemical cycles should distinguish between the two parts, or as if the two cutoff: 1) *reserve fund* - is a huge mass of moving material, non-organisms; 2) *exchange fund* - much smaller, but very active due to the direct exchange of nutrients between organisms and their immediate environment. If we consider the biosphere as a whole, it can be distinguished: 1) cycling of gaseous substances with a reserve capacity of the atmosphere and hydrosphere (ocean) and 2) sediment cycle with a reserve fund in the crust (the geological circulation).

All organisms survive more because wherever it was any of their habitat exists biogenic current of atoms. This current could not take place in any case, under terrestrial conditions, if any soil.

Soil - a key component of the biosphere, providing, along with oceans a decisive impact on the global ecosystem as a whole. It is the soil nutrient supply power plants that feed the entire world heterotrophic. The soils in the world are diverse and their fertility is also different.

Fertility depends on the amount of humus in the soil and its accumulation, as well as the power of the soil horizons depends on the climatic conditions and terrain. Most are rich in humus soil steppe, where there is a fast humification and mineralization is slow. Less rich in humus forest soil, where mineralization is ahead of humification rate.

Allocate on various grounds many soil types. Under soil type refers to a large group of soils formed under similar conditions, and is characterized by a certain soil profile and soil formation orientation.

Because the most important soil-forming factor is climate, then, to a large extent, the genetic soil types coincide with the geographical zoning: *Arctic and tundra soils, podzolic soils, black earth, brown, gray-brown soils, and sierozems, ultisol and zheltozomy.*

Soil formation time depends on the intensity of humification. The rate of accumulation of humus in the soil can be defined in terms of measuring the power (thickness) of the humus layer with respect to time and the formation of, for example, in mm / year. These figures are given in Table.

Knowing the rate of accumulation of humus and humus horizon, it is possible to calculate the age of various types of soil (Gennadiev, 1987). On the Russian plain black soils formed over years 2500-3000, gray and brown forest soils - for 800-1000 years podzolic for about 1500 years. soil formation rate depends on the type of parent material - granite in the wet tropical climate for the formation of this soil should be 20,000 years old.

Table 7 - **Rate of formation of humus soil horizon Russian plain (for A. N. Gennadievichu et al., 1987)**

soil Group	Speed, mm / year
Mountain meadow, mountain forest-meadow	0.80-1.00
Peat-gley, bog-podzolic	0,50-0,80
Sod-carbonate, ashed	0.45-0.50
Chernozems ashed typical	0,40-0,45
Gray forest, chernozem ordinary	0.35-0.40
Southern black soils, dark-brown, sod-podzol	0.20-0.30
Podzols and typical podzolic	0.10-0.20
Salt licks, light brown	less than 0.10

These data quantify acceptable washout with vigorous human influence. At the same time they show how easy it is to destroy this fine "brown tape", and how much time, not counting the cost to recover spent.

Soil is the boundary layer between the atmosphere and biospheric part lithosphere. In it there is not only a mixture of live and dead component in nature, but their interaction within the soil ecosystem. The main purpose of this ecosystem - ensuring the cycle of matter in the biosphere.

A man from the point of view of evolution laws

Origin. According to the prevailing view of the modern man evolved from the African branch of the progressive Neanderthal man as a subspecies of the species Homo sapiens L. - Homo sapiens sapiens. It was found that all modern humanity has a single genotypic identity, derived conventionally from

the genotypes of one woman and one man. Prove it American, British and Japanese geneticists call them respectively "mitochondrial Eve" and "the Y-chromosomal Adam».

It is assumed that their "meeting" took place somewhere in East Africa about 150,000 years ago. Before that human ancestors have evolved from one of the most progressive forms of African higher catarrhini that lived in trees (driopithecus; 22-12 million years ago), to the oldest person - archanthropines, or Homo erectus (Homo erectus, 1,5-0, . 3 million years ago, the former name - the genus Pithecanthropus). Between these steps the evolutionary ladder series of transitional forms was presented, in particular, a native Australopithecinae (5-I million. Years ago). The origin and evolution of man are inseparable from the evolution of living nature and largely determined the environmental changes on Earth.

Human evolution has a number of features that are important for the understanding of biology and human ecology. In apelike human ancestors was not far advanced morphological, physiological and ecological specialization. Shallow specialization meant an increased adaptability in evolutionary terms, the potential ability to branched evolution flexible adaptive behavior and engage in various ecological niches. Human evolution is not only proves the rule acceleration of evolution, but also unprecedented in speed for large mammals, especially in the latter stages of anthropogenesis. Man - one of the youngest species of large animals on Earth.

Evolutionary young man combined with features infantnosti, "childish" - incomplete careful selective adjustment of biology of the species to the conditions of existence. High adaptability, lack of complete set of conservative instincts and varied instrumental activities resulted from human ancestors extraordinary development of higher forms of behavior, it nadinstinktivnoy sphere and intellect. The final stages of anthropogenesis are marked the emergence of a culture - together means of wealth creation, voice and character information transfer and learning through imitation and the signal memory. Culture becomes the dominant factor in human evolution, weakening the pressure of natural selection factors. Due to the transfer of skills training, skills and knowledge from one generation to another - there are cultural inheritance, tradition.

Thus man in his evolution as it overcomes a ban on the nature of the inheritance of acquired characteristics. Culture, cultural inheritance are the main source of a society and civilization. Assimilation of cultural information

in the society takes place far more rapidly than the inheritance of genetic information.

Therefore, the pace of social progress and development of material culture is not only ahead of the biological evolution of man, but also because of the weakening of natural selection slow her.

The main factors of anthropogenesis, which impacted on the environment Homo sapiens, can be summarized as follows. The origin of the forms with arboreal predetermined such biological features of human ancestors, as a preference for the vertical position of the body, the reduction of the sense of smell, an increase in the severity of color vision, while reducing the number of young being born female. The frontal position of the eye and provided a good stereo ranging function of which is essential for accurate jumps.Exclusively developed prehensile function and increased tactile sensitivity facilitated further development of multi-functional hand.

About 10 million. Years ago, tropical climate in Africa has changed significantly, and in large parts of the forest was replaced by savanna. This led to the transition of our ancestors to a terrestrial lifestyle and becoming bipedal locomotion. Exemption forelimbs led to the development of instrumental activities and the use of guns. Change ecotypes and the nature of power (the transition from a purely vegetable diet to the mixed) require an increase in the stern area and increased energy expenditure while getting food. And this, in turn, required higher calorific value and digestibility.

By grazing and gathering supplemented hunting and eating animals. It appeared the first stone tools. Growth of consumption of animal foods has caused changes in digestion, metabolism, increase in body size and increased aggressiveness. This in turn led to the development and consolidation of the ability to kill their own kind and to cannibalism. Together with the manufacture and use of increasingly sophisticated tools began to use fire, bones and animal skins. Loss of hair (as a result of changes in environmental conditions, hormonal status, the need to get rid of ectoparasites and the appearance of clothing) was accompanied by the improvement and development of thermoregulatory sweating.

Along with high energy consumption and a change in the composition of the food it led to an increase in demand for water, to the approximation of forage areas to reservoirs and in the future - to the settlements near the water. Mastering of ecotopes open spaces and increase forage areas has changed the social organization of groups arhan- tropes. An important place in anthropology took transform reproductive function and sexual relations. At some point, an

unprecedented for the higher animals, was lost seasonality and short duration of sexual excitability females and related breeding season. Intensified politsiklichnost shortened estrus and sexual cycle. Female into a woman.

At the transition to the predominantly elongated litter singleton pregnancy and during feeding of a baby, as well as the total duration of caring for the offspring. Off-season libido and the ability of continuous sexual activity resulted in an increase in sexual behavior and sexual subjection to the structure and dynamics of age-sex composition of the tribal groups, as well as become a prerequisite for the emergence of the family. All of these factors, most notably the instrumental activities, the expansion of the emotional sphere and nadinstinkgivnyh motives led to the rapid development of the brain, the development of intelligence, memory, associative thinking. On this basis there was articulate speech.

This has created a qualitatively new information environment, significantly increased the volume of information processed by the brain, and thereby stimulate even greater acceleration of its development. It is at this phase have to go to early forms of Homo sapiens.

Speech and the ability to create characters, drawings and sculptures, ie art and sign coding of information became the basis the subsequent development of the cultural inheritance.

The final stages of anthropogenesis and begin the process of human settlement coincided with major variations in climate - change of the ice ages and interglacial Vij in the Northern Hemisphere. In the tropics it is accompanied by alternating periods of high humidity with the epochs of prolonged drought. Lack of food and competition aggravation accelerated resettlement of Homo erectus, the earliest forms of which even before that penetrated from Africa to South Asia. He later 300 thousand. Years ago archanthropines appeared in North Africa and Southern Europe. In the period between 100 and 40 thousand. Years ago, early humans spread in the temperate zone, and then in the northern parts of Eurasia, about 50 thousand. Years ago turned out to be in Australia, and 30 thousand. Years ago, or a little later through Beringia, and possibly through Polynesia entered the American continent. Human settlement accompanied by the emergence of racial and ethnic polymorphism, the birth of nations.

The high genetic adaptability of the earliest representatives of Homo sapiens significantly complement extraordinarily increased possibilities of adaptive behavior. Skills to optimize the microenvironment, fire, clothing, housing, production and use of more sophisticated instruments, ie. E. The

beginnings technogenesis contributed to the development of various natural areas and different patterns of natural resources. Caused ethnic groups have become essentially ekologogeograficheskimi life forms of the species Homo sapiens (JI. Gumilev, 1990). The history of human society has been studied for a long time outside of natural science itself, although constantly had to refer to the environmental factors of historical formations and events.

Still prevalent notion that the human dependence on nature, the smaller the higher the cultural level and technical equipment.This is one of the most dangerous misconceptions, accompanying the just the low cultural level, and even at a high technical equipment. Owning the latest in no way diminished the vital human need for a product of nature - air, water and food, dependence on environment-forming and work sredoreguliruyuschey living organisms. Moreover, he writes NN Moiseev (1994): in the present conditions of human dependence on natural factors has multiplied since the exponentially growing impact on the nature of the changes (also exponentially) he / nature, and hence the living conditions of people. Modern ecology as it is presented in the statement of Yu Odum (§ 1.1) and the justification CHEBS system (§ 2.4), had essentially the right to the joint examination of natural history and the history of society in the spirit of Russian cosmists - DI Mendeleev, KE Tsiolkovsky, AL. Chizhevskogo, VI Vernadsky in the natural sciences, NF Fedorov, BC Solovyov, IV Kireyevski, PA. Florensky - in philosophy, and in our time - JI.H. ENU (1990) NF Reimers (1994). and NN Moses (1994, 1996). This possibility is very clearly predicted by Marx:

The story itself is a real part of natural history, the formation of the nature of man. Subsequently, the natural sciences include the science of man to the same extent that the science of man will include natural science: it is a science.

Human ecological niches

Evolution of ecological niches. In contrast to the ecological niches of animal niches person constantly changing, increasing with increasing speed along with the stages of historical development of mankind. Basic realized ecological niche of primitive man is largely dependent on its energy needs. In accordance with the data on body size average specific human power consumed was close to 2 W / kg, and heat dissipation - to 75 W / m2, which determined the need for food (up to 1/12 of body weight per day) and climatic environmental conditions, characteristic seasonally humid tropical zones. Early archanthropines occupied niche collectors grazing food chains with relatively maloy- share of animal food. They were forced to do more work on food production and to develop a large feeding territory. The beginning of the use of

fire and increased consumption of animal foods increased the ecological space man to niche primitive hunters and fishermen. The same period applies to the use of fire for burning forests, first for systematic hunting purposes, and then for slash-and-burn agriculture.

M.Ichas (1994) calls this the first environmental revolution comparable in its effects with later revolutions - agrarian and industrial. History of "conquering nature" and ecocide - the destruction of natural ecosystems - you can start with the Paleolithic, as the instigators to the ancient nature necessarily the loss of large areas of forests and their many inhabitants in the area of sub-Saharan Africa, in Europe and in East Asia. The transition to agriculture significantly reduce the need for individual feed area and brought food consumption almost to the level of net primary production of cultivated plants primitive agrocenoses. At the same time it demanded of growth of total costs controlled human energy per unit of production (including the cost of manufacturing of tools, handling and processing of crop land, and the energy of draft animals). All this, together with the Settlement, the creation of permanent settlements and the necessary division of labor meant the emergence of a sustainable material culture - the emergence of civilization.

From an environmental point of view, it was largely fortuitous, because it required a rare coincidence of a number of conditions: a relatively high population density in the fertile terraced valleys seasonally humid tropics or subtropics, where there were plants suitable for cultivation and animals suitable for domestication. No wonder the ancient centers of civilization arose independently in all three small regions - in the south of Mesopotamia, in the middle reaches of the Mekong and the south of Peru. In limited areas of development man could not get the right amount of animal food.

Therefore, the spread of agriculture was accompanied by the development of animal husbandry and pasture management, as well as the development of nomadic pastoralism. Since the weight of livestock production on the order of less than the feed, to obtain at least 1/10 of the food in the form of animal food a person had to have a livestock biomass, the biomass equal to men, and pasture area - not less than the area of arable land. Human consumption Most of the products agrocenoses excluded the possibility of natural recovery of biomass plants and soil fertility.

The man was forced to take over the function of reproduction, processing annually, fertilizing and sowing fields. The spread of agriculture and animal husbandry have led to the development of large areas of the subtropics and temperate zone and to increase the number of people. This territorial niches

large human populations have been identified. Inside them, thanks to the increased productivity of agriculture and the deepening division of labor, there were conditions for the development of crafts, trade and the concentration of people in cities.

The use of cars and fossil fuels significantly increase the yield of agricultural products, enter new territory and expand the area under cultivation. Ho at the same time it strongly increased the energy consumption of the production of food and provide other human needs. Real concentrates energy (coal, oil and gas) were for this universal currency and sources of wealth. By the end of XX century. the average energy consumption per one inhabitant of the planet, is 25 times greater than his need for food energy. Over the past 100 years the energy costs for the production of l t of wheat increased by 100 times, and is now much higher than the energy contained in the mass of grain. Each mode power supply, in particular energy with food for long-term existence of the population can be considered as equivalent energy ecological niche. For the bulk of humanity is characterized by a steady increase in energy deposition density per unit area. Ego leads to population growth and faster than population growth, increased energy consumption of all mankind, including the anthropogenic share consumption of products of the biosphere.

These trends are consistent with the law of maximization of energy and information, which largely determines the evolution of biological systems. Higher animals evolve towards an optimal combination of performance and energy efficiency, while the man prefers power, often neglecting efficiency. In animals with an increase in energy consumption intensity increased forage area and reduces energy consumption density. Animals, violate this requirement, destroyed biocenosis, undermine its food supply and dying. Along this path is and people.

The history of man-made environmental crises. With the advent of private human imbalance in the biosphere we have acquired a qualitatively new character and a completely different pace. Mankind was in niches primitive gatherers and fishermen with the minimum biological power 200 thousand years; in the recesses of primitive agriculture, cattle breeding and hunting with the power, twice as much - 10 thousand years. in the niche of traditional farming with draft animals at the fivefold energy consumption - 1000 years; in a niche in the industrial world with multiple power 20 - 100 years. This acceleration of growth of energy - the main cause of the environmental crisis. The above sequence here - this is not a formal historical periodization.

And the current environmental crisis is not the first in the modern history of the biosphere. N.F.Reymers (1994) identifies a glad environmental crises and the subsequent ecological revolution (Fig. 30).

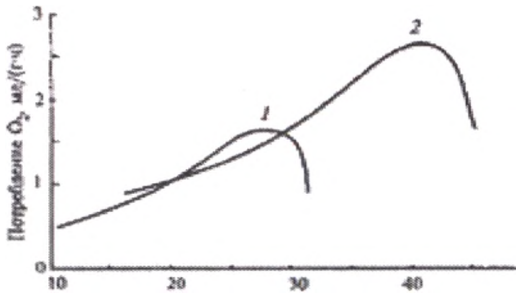


***Figure 30** - I. Environmental crises and revolutions in the history of civilization scale conditional*

In relation to most of them it is not vdet global change ecology of biota and on the stages of change of regional ecological niches rights. The most important of these crises ancient gathering and fishing that led to the transition to the productive economy, and the crisis of the producers, ie exhaustion of resources of wood for fuel and construction, and also reaching the limit of productivity domashinnogo agriculture. These circumstances have become one of the incentives of the Industrial Revolution and the development of industrial civilization, which led to the current crisis. And each of these steps was accompanied by a significant expansion of the ecological niche of humanity.

Modern ecological crisis called decomposers crisis because the totality of decomposers of the biosphere is already unable to cope with the destruction of the enormous mass of man-made pollution. This is combined with the deficit and the threat of exhaustion of many mineral resources. Modern ecological crisis' Unlike previous acquired truly global and growing rapidly on the historical scale. Next, we touch on two subsequent crises and revolutions, the projected scenario NF Reimers. Wednesday of modern life.

A set of conditions in which people live today, much wider than the usual understanding of the ecological environment, such as that described in Sec. 4. Human Environment in addition to the factors common to all the land animals of the natural environment includes more created by human physical environment and the social environment. They form a single complex system of interacting factors. Manmade material medium includes: I) the elements of the

environment, modified by man: landscapes converted (conversion steppe field, woods - in park, the River - in the reservoir), modified mesoclimate, a composition of organisms in the environment, deviations from the natural composition and physico chemical properties of air, water, soil, etc. - the so-called kvaziprirodnuyu environment; artificial elements: buildings, air-conditioned climate; noise, electromagnetic field, ionizing radiation, substances, materials and products - different means of production and consumption, which in combination with the element cops kvaziprirodnoy medium form arteprirodnuyu medium. It is also known as man-made environment.

The elements of the built environment as an artificial ecosystem - agrocnosises, field, park, canal, road, etc. - are not able to samopodtserzhaniyu; if one leaves them, they are either degraded and destroyed or exposed to natural succession, gradually turning into objects of wildlife.

At the junction with the social environment technogenic medium comprises a residential environment, ie, Wednesday dwellings and settlements, and the working environment - environment of workplaces and environments of production facilities. In some vitsah activities that require insulation from the external environment (underwater and space vehicles), a person is completely in an artificial environment. The social environment of man - a certain way organized set of connections of people - from the family to the ethnic group or the state of society, which are formed and met the psychological, cultural, social and economic needs of the individual.

Without material medium man can not live as a living being, no social environment a person does not become a person in the full sense of the word, because deprived of the cultural inheritance. The level of development of society, the degree of civilization depend on the physical structure of the medium - the relationship between the natural and man-made human environment and the relationship between the physical and social environment.

Determination of the human environment is, in UN documents and legal regulations in some countries.

The Stockholm Declaration of 1972 states: a person is both a product and a creator of his environment, which gives him a physical basis for life and provides an intelligent, moral, social and spiritual development, and beyond: so for the human being and the enjoyment of basic rights of people, including the right to life, the importance of the two aspects - the natural environment, and one that has created man Placement of the population. Geographical area of the ecological niche Homo sapiens takes a few more than 3/4 of the land area

(excluding Antarctica) - about 105 mln.km2 and many times bol -. Chez any other species range of terrestrial animals. He populated only polar regions (permanent settlement located just south of 78 ° N and north of 54 ° S), the highlands above 5000 meters and the main area of most major Asian and African deserts. LNGumilev wrote in 1990: of He sledoeg think that somewhere tbud is "virgin" land, where no man has gone before. Today's desert and jungle filled with traces of paleolithic sites: Amazon forests grow on soils pereotpozhennyh once destroyed agriculture ancient inhabitants; even on the cliffs of Obadiah and the Himalayas found traces misunderstood our facilities. In other words, during the period of its existence vTsts Homo sapiens witnessed several serious and constantly modify their distribution in the Earth's surface. He, like any other kind, sought to master the greatest possible space with the highest possible density of population.

Currently, the most densely populated areas of the world that make up about 7% of the land is concentrated over 70% of the population. Over 90% of people living in the valleys and their tributaries at altitudes of less than 1000 m. 200 km strip along sea coasts (16% of the land) 50% of people live.

The average density of population ecumene of the Earth about 55 people per km^2 l; it varies greatly in different regions and continents - from 3.2 in Australia to 103 in Orthodox Europe.

In the European part of Russia, the average density is 29, and in Asia - less than 2.3 persons / km^2. Density due to natural conditions provide the main real-energy and climate needs of the people, as well as the placement of productive resources.

The largest city, and at the same time very distant from the natural environment, extreme in many respects the ecological niche of modern humanity - the city. The city reached the highest concentration of man-made energy. For example, in the metropolitan area of New York from 2100 km2 and a population of 16.8 million. People (in 1994) per inhabitant of 125 m2 area of the city and 28 kW of total power consumption. In cities around the world are now nearly half the world's population. Over the past 45 years, the number of urban residents rose from 729 million. Up to 2.54 billion. People, ie increased almost 3.5 times and their share in the total population increased from 29 to 44%. In this case, the predominant role played by the growth of large cities; by the end of 1995 in the world there were 320 cities with populations of more than I million and 48 cities with a population of over 5 million.. However, the process of urbanization (from the Latin urbanus -. City) is not limited to the growth of the urban population and the number and size of cities.

It manifests itself in an increase in the city's role in society, in changing the lifestyle of large masses of people. For human ecology in the city is characterized by isolation from natural environmental factors: the availability of the necessary mass of plants, living soil and water involved in purifying the environment.

The clash between the biological nature of man, and the results of its activity reaches protivoprirodnoy in critical acuity. Modern city - is a complex socio-economic organism, formed by demographic, economic, geographical, engineering and construction, architectural factors, a variety of economic relationships with the surrounding space and the natural environment. With anti tropoekologicheskih positions of city - it is first and foremost a very dense and dynamic human population to set up her own artificial environment. With the city binds many of the features of social progress. Ho urban civilization - the convenience, comfort, welfare relief, communications density, large selection and availability to meet the diverse needs - has not only the good.

The urban environment has a significant negative impact on the most important quality of a person - his health in the broadest sense. Air pollution, water, food, household items emissions of industry and transport, electromagnetic fields, vibrations, noise, air dezionizatsiya indoor, household use of chemicals, excessive flow of information, the excessive number of social and anonymous contacts, lack of time, lack of exercise when strenuous simulation activities emotsiogen- nye overload deficiencies in the diet, the spread of harmful habits - all this in a variety of combinations is increasingly becoming a source of numerous premorbid state and then and disease. In essence unwittingly citizen is in an environment of decent cooler. By many objective indicators of significant numbers of the population of large cities are constantly in a state of stress, similar to the degenerative stress extremely overcrowded populations of small animals. NN Moiseev (1994) called this state "phenomenon lemmings", referring to a similar suicide mass destruction of these subarctic animals, often following outbreaks of reproduction and strong overpopulation their habitats.

The overwhelming majority of citizens prefer to relax, spend their holidays outside the city, close to nature - in a natural ecological environment. Ho stay in her short-lived, really friendly places getting smaller, and the desire to combine pastoral comfort makes this holiday more expensive. In addition to the popular holiday destination is growing rapidly permissible recreational load and they can easily turn into a continuation of the city.

Human adaptation. The oldest species (genotypic) Homo sapiens adaptation associated with a device to geographically contrast to natural conditions and form races - Caucasoid, Mongoloid, Negroid Australasian and small races (nadetnosov) inside these large races. For modern humanity is characterized by a significant cross-breeding process - miscegenation. Racial differences are a small number of minor morphological traits - skin color, hair, eyes, nose shape, lips, eye shape, height, and body proportions and features of blood groups and the activity of certain enzymes. For each of these symptoms can be traced to a certain connection with the factors of geographical distribution, genetic isolation, climate and dietary habits. Thus, the proportions of the body - chunky or elongation, the relative length of the arms and legs, the average thickness of subcutaneous fat, especially the facial skeleton and other signs of people - are correlated with an average annual temperature of habitat and as well as in animals, subject to the rules of Bergman and Allen.

On genotypic human adaptation constantly overlap physiological adaptation - acclimation. Metabolism and energy a person is very plastic. This refers to the level and quality of metabolism structure. Therefore, man can adjust (especially resulting from an intermittent mode acclimation - training) to a wide range of changes in environmental factors and physiological conditions - temperature, atmospheric pressure, oxygen concentration, composition pitssch, muscular load awake mode, etc. Physiological adaptation to the cold climate people accompanied by increased metabolism, temperature sensitivity change exposed portions of the body, the depth of breathing, food preferences shift towards an increased caloric intake. Due to the change in peripheral blood flow and an increase in the subcutaneous fat layer improves the thermal insulation of the organism and reduces the load on heat buildup in the muscles: attenuated, and then disappears cold shivers.

Adapted to cold person at low temperatures is capable of a significant drop in enthalpy in the body without increasing the physiological stress. The adaptation to a hot climate is achieved circulatory changes, water-salt balance, decrease blood pressure, a better matching of the kidneys and sweat glands, some general decrease in metabolism. All these changes are controlled by the nervous and endocrine systems. Significant differences in the traditional diet of some ethnic groups of people are not genetically caused; they indicate a greater physiological adaptability of different human populations with respect to the composition of available food. Relatively few distinct total calorie diet achieved with different ratio of traditional sources of carbohydrates, fats and proteins, and nutritional status - a plurality of sets of products, including plant and

exclusively. The ability to individually climate adaptation depends on the race and macroethnic toiletries, gender, age and general physical health. Ho, in most cases, related to the masses of people, the adaptation to a particular climate is not so much by functional adaptation, but rather because of the psychological motivation, adaptive behavior and environment-conditioning technology.

Test tasks for self-control:

1. What is the name of the hypothesis that life on Earth was brought from outer space and settled down here after favorable conditions for it were created on Earth?

a) panspermia;
b) the stationary state;
c) Creationism;
d) abiogenesis.

2. What scientist expressed in 1924 the assumption that the living appeared on the Earth from inanimate matter as a result of the chemical evolution of complex chemical transformations of molecules?

a) S. Miller;
b) AI Oparin;
c) VI Vernadsky;
d) E. Leroy.

3. The sphere of mind, the highest stage of the development of the biosphere, when intelligent human activity becomes the main, determining factor in its development, is called ...

a) technosphere;
b) anthroposphere;
c) noosphere;
d) biosphere.

4. The importance of the ozone layer for the biosphere is that it absorbs ...

a) ultraviolet radiation;
b) infrared radiation;
c) X-ray radiation;
d) visible light.

5. The second Pasteur point, associated with the formation of the ozone layer and the release of living organisms to the surface of the land, corresponds to the oxygen content in the atmosphere, equal to ... from the modern.

a) 25%;
b) 50%;
at 5 %;
d) 10%.

6. The first point of Pasteur is the achievement of such a level of oxygen content in the Earth's atmosphere, at which life became possible ...

a) anaerobic;
b) aerobic;
c) reptiles;
d) mammals.

7. How long did it take since the first multicellular organisms appeared?

a) ~ 500 million years;
b) ~ 750 million years;
c) ~ 300 million years;
d) ~ 1 billion years

8. The appearance of the first successful terrestrial plants is dated by age

a) ~ 410 million years;
b) ~ 220 million years;
c) ~ 730 million years;
d) ~ 55 million years.

9. What is the age of all bodies of the solar system and the Earth?

a) ~ 3.5 billion years;
b) ~ 6 billion years;
c) ~ 2.5 billion years;
d) ~ 4.5 billion years

10. When did the oldest blue-green algae (cyanobacteria) appear?

a) ~ 3.4 billion years ago;
b) ~ 1.5 billion years ago;
c) ~ 2 billion years ago;
d) ~ 1 billion years ago.

THEME 7. THE CYCLE OF SUBSTANCES AND THE BASIC BIOGEOCHEMICAL LAWS OF V.I. VERNADSKY

7.1 Cycle of substances in nature Basic properties of the biosphere

7.2 main cycles of substances in nature are two: large (geological) and small (biogeochemical).

The great cycle of substances in nature (geological) is caused by the interaction of solar energy with the deep energy of the Earth and redistributes substances between the biosphere and the deeper horizons of the Earth. Sedimentary rocks formed due to weathering of igneous rocks in the mobile zones of the earth's crust are again immersed in a zone of high temperatures and pressures. There they are remelted and form magma - a source of new igneous rocks. After raising these rocks to the earth's surface and the effects of weathering processes, they again transform into new sedimentary rocks (Fig. 32). The symbol of the cycle of substances is a spiral, not its circle. This means that the new cycle of the cycle does not exactly repeat the old one, but introduces something new, which in time leads to very significant changes.

A great cycle is the water cycle between land and ocean through the atmosphere. The moisture evaporated from the surface of the World Ocean (which is spent almost half of the incoming solar energy to the Earth's surface), transfers to land where it falls as precipitation, which again returns to the ocean in the form of surface and underground runoff. The water cycle also takes place according to a simpler scheme: the evaporation of moisture from the surface of the ocean - the condensation of water vapor - precipitation on the same water surface of the ocean.It is estimated that more than 500 thousand km^3 of water annually participate in the water cycle on the Earth.The water cycle as a whole plays a major role in shaping the natural conditions on our planet. Taking into account the transpiration of water by plants and its absorption in the biogeochemical cycle, the entire reserve of water on Earth disintegrates and recovers over 2 million years.

A small cycle of substances in the biosphere (biogeochemical), unlike a large one, occurs only within the biosphere. Its essence in the formation of living matter from inorganic compounds in the process of photosynthesis and in the transformation of organic matter when decomposed again into inorganic compounds. This cycle for the life of the biosphere is the main one, and he

himself is the product of life. Changing, being born and dying, living matter maintains life on our planet, providing a biogeochemical cycle of substances.

The main source of energy of the cycle is solar radiation, which generates photosynthesis. This energy is rather unevenly distributed over the surface of the globe. For example, at the equator, the amount of heat per unit area is three times larger than in the Svalbard archipelago (800 north latitude). In addition, it is lost by reflection, absorbed by the soil, consumed by transpiration of water, etc. and, as we have already noted, no more than 5% of the total energy is spent on photosynthesis, but more often 2-3%.

In a number of ecosystems, the transport of substances and energy is carried out mainly through trophic chains.

This cycle is usually called a biological cycle. It involves a closed cycle of substances, repeatedly used by the trophic chain. Certainly, it can take place in aquatic ecosystems, especially in plankton with its intensive metabolism, but not in terrestrial ecosystems, with the exception of rainy tropical forests, where the transfer of nutrients "from plants to plants", whose roots are on the soil surface, can be ensured.

However, such a cycle is impossible on the scales of the whole biosphere. Here there is a biogeochemical cycle, which is the exchange of macro- and microelements and simple inorganic substances with the substance of the atmosphere, the hydrosphere and the lithosphere.

V.I. Vernadsky called the cycle of individual substances biogeochemical cycles. The essence of the cycle is as follows: the chemical elements absorbed by the body, then leave it, leaving in the abiotic environment, then, after a while, again fall into the living organism, etc.

Those elements are called biophilic.The most vital substances can be considered substances, of which protein molecules mainly consist. These include carbon, nitrogen, oxygen, phosphorus, sulphur.

Biogeochemical cycles of carbon, nitrogen and oxygen are the most perfect. Due to large atmospheric reserves, they are capable of rapid self-regulation. In the carbon cycle, more precisely - the most mobile form of it - carbon dioxide, the trophic chain is clearly traced: producers that capture carbon from the atmosphere during photosynthesis, consumers - carbon absorption along with the bodies of producers and consumers of lower orders, decomposers - returning carbon again in the cycle. The rate of turnover of carbon dioxide is about 300 years (complete replacement in the atmosphere) (Figure 32).

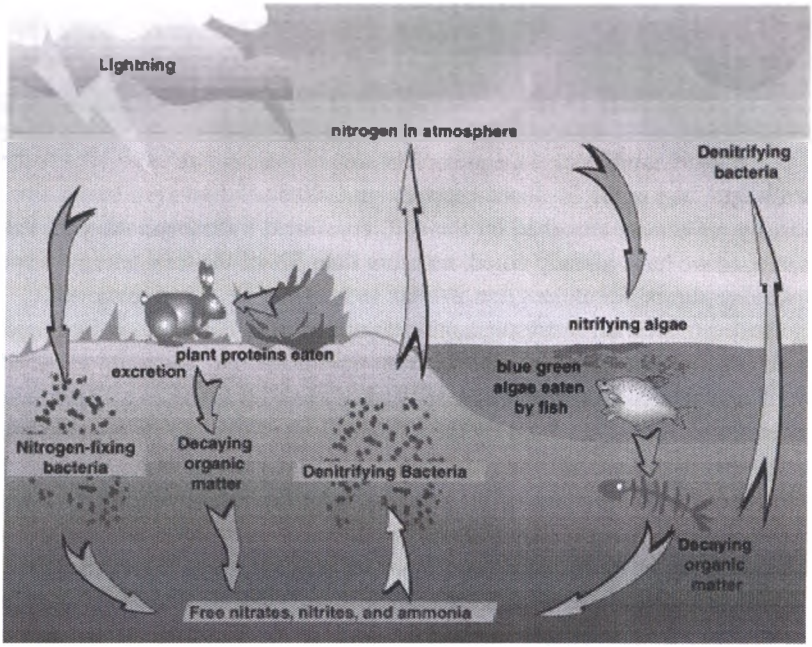


Figure 32 *- Rate of circulation of substances*

In the World Ocean, the trophic chain: producers (phytoplankton) - consumers (zooplankton, fish) - decomposers (microorganisms) - is complicated by the fact that some part of the carbon of a dead organism, sinking to the bottom, "leaves" for sedimentary rocks and participates no longer in biological, but in the geological circulation of matter.

The main reservoir of bio-linked carbon are forests, they contain up to 500 billion tons of this element, which is 2/3 of its stock in the atmosphere. Interference of a person in the cycle of this element leads to an increase in the content of carbon dioxide in the atmosphere. (Figure 33)

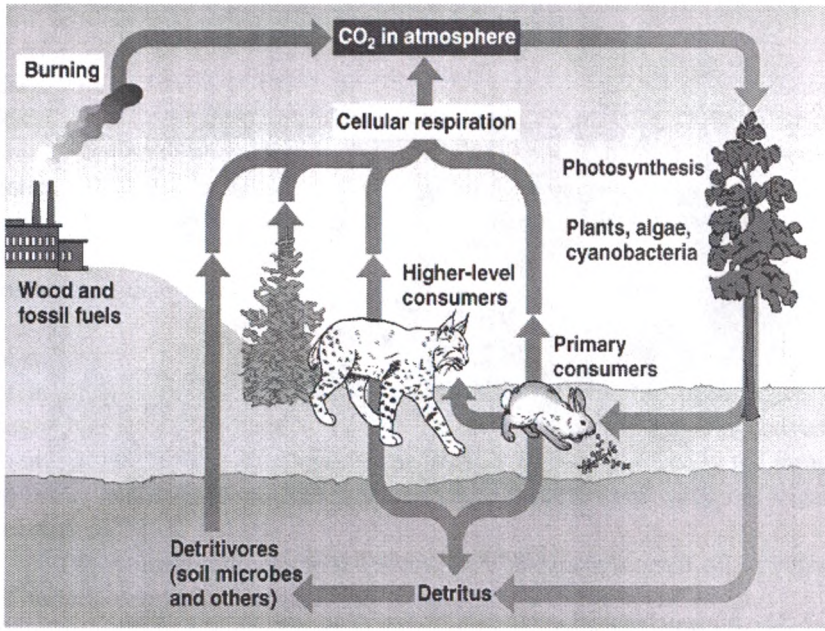


Figure 33 - *Circuit diagram of carbon*

The speed of the oxygen cycle is 2 thousand years (Figure 34), it is during this time that all the oxygen of the atmosphere passes through the living matter. The main supplier of oxygen on Earth is green plants. Every year they produce 53*109 tons of oxygen on land, and 414*109 tons in the oceans.

The main consumer of oxygen is animals, soil organisms and plants that use it in the process of breathing. The process of oxygen cycling in the biosphere is very complex, as it is contained in very many chemical compounds.

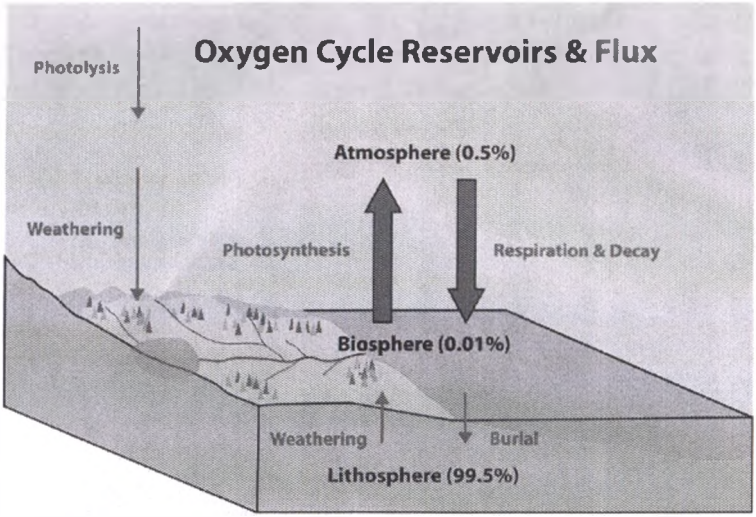


Figure 34 - *oxygen cycle*

The biogeochemical cycle of nitrogen is no less complex than carbon and oxygen, and covers all areas of the biosphere. (Figure 35)

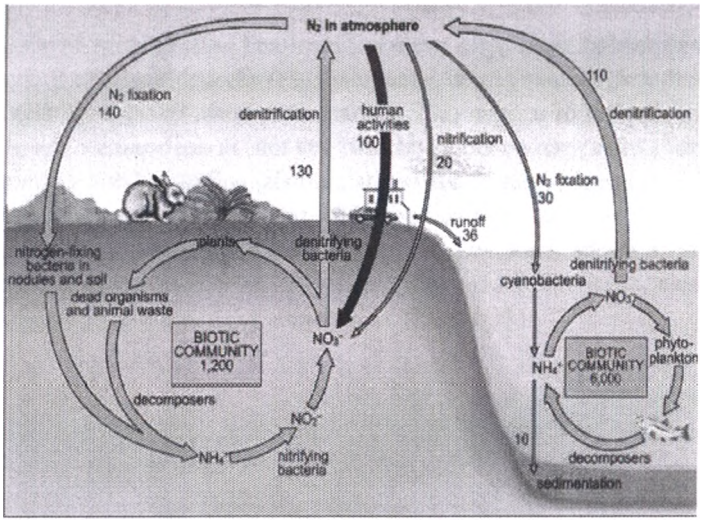


Figure 35 - *Scheme of the nitrogen cycle in the biosphere*

Absorption of its plants is limited, as they assimilate nitrogen only in the form of its connection with hydrogen and oxygen. And this despite the fact that the nitrogen reserves in the atmosphere are inexhaustible (78% of its volume). Reducers (destructors), specifically soil bacteria, gradually decompose the protein substances of dead organisms and convert them into ammonium compounds, nitrates and nitrites. Some nitrates enter the process of circulation into the groundwater and pollute them.The danger also lies in the fact that nitrogen in the form of nitrates and nitrites is assimilated by plants and can be transmitted along food (trophic) chains.

The second source of nitrogen for plants is the result of the decomposition of organic substances and, in particular, proteins (proteins) by a special group of ammonifying organisms. At the same time, ammonia is formed in the beginning, which, as a result of the activity of nitrifying bacteria, is converted to nitrites and nitrates. Part of the nitrogen plants are assimilated in the form of ammonium and urea ions, formed as a result of the decomposition of organic substances.

The return of nitrogen to the atmosphere occurs as a result of the activity of bacteria-denitrifies, decomposing nitrates to free nitrogen and oxygen.

A significant part of nitrogen, falling into the ocean (mainly with the flow of water from the continents), is used by aquatic photosynthesizing organisms (primarily phytoplankton), and then, falling into the animal feeding chain, partially returns to land with marine products or birds. A small part of the nitrogen, like carbon, falls into the sedimentary compounds. Biogeochemical cycling in the biosphere along with oxygen, carbon and nitrogen, many other elements that make up organic substances, such as sulfur, phosphorus, iron, etc.Biogeochemical cycles of phosphorus and sulfur, the most important biogenic elements, are much less perfect, since, in the "inaccessible" fund.The sulfur and phosphorus cycle is a typical sedimentary biochemical cycle. Such cycles are easily violated from various kinds of influences, and some material exchanged leaves the cycle. Return to the cycle again, it can only as a result of geological processes or through the extraction of living matter biophilic components. Sulphur is one of the most dangerous pollutants. Its cycle is shown in Fig. 36.

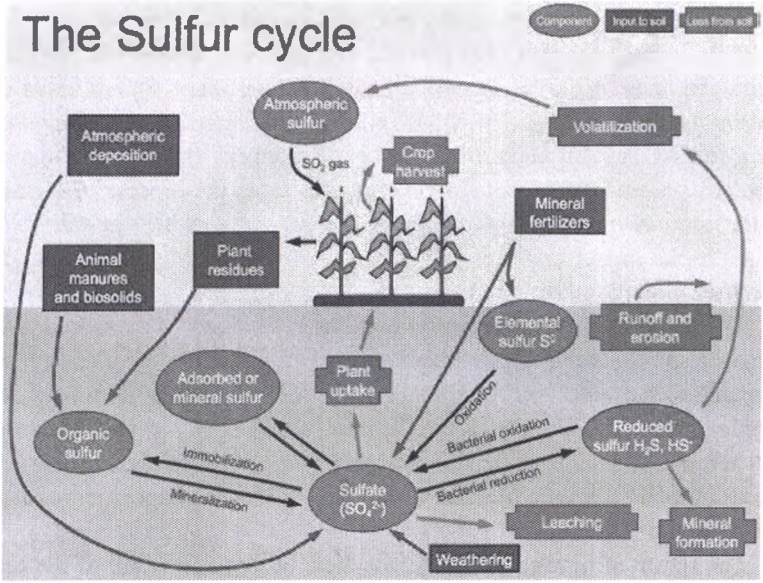


Figure 36 *- The sulfur cycle in the biosphere*

Sulphur also has a basic reserve fund in sediments and soil, but unlike phosphorus has a reserve fund and in the atmosphere. In the exchange fund the main role belongs to microorganisms. Some of them are reducing agents, others are oxidizers.

In rocks, sulfur is found in the form of sulfides, in solutions - in the form of an ion, in the gaseous phase in the form of hydrogen sulphide or sulfur dioxide. In some organisms, sulfur accumulates in pure form and when they wither away, deposits of native sulfur are formed on the bottom of the seas.

In the marine environment, the sulphate ion occupies the second place in content after chlorine and is the main accessible form of sulfur, which is reduced by autotrophs and is included in the composition of amino acids.

In terrestrial ecosystems, sulfur returns to the soil with the death of plants, is captured by microorganisms that restore it to hydrogen sulfide. Other organisms and the effect of oxygen itself lead to the oxidation of these products. The sulfates formed dissolve and are absorbed by the plants from the pore soils - so the cycle continues.

However, the sulfur cycle, as well as nitrogen, can be disturbed by human intervention. The fault is primarily the burning of fossil fuels, and especially

coal. Sulfur gas disrupts the processes of photosynthesis and leads to the death of vegetation.

Circulation of phosphorus. A different cycle is characteristic for phosphorus (Figure 37), in the cycle of which there is no gaseous phase. After repeated consumption of it by organisms on land and water, it is eventually excreted into bottom sediments. The return of phosphorus with the organisms of the ocean does not compensate for its needs on land. Not compensated for these needs and as a result of the use of natural mineral compounds. In this case, a one-sided process, ending in a sedimentary cycle, threatens with phosphorus deficiency for organisms. The latter is largely replenished by man through the introduction of mineral fertilizers, which are mainly products of processing marine sedimentary rocks.

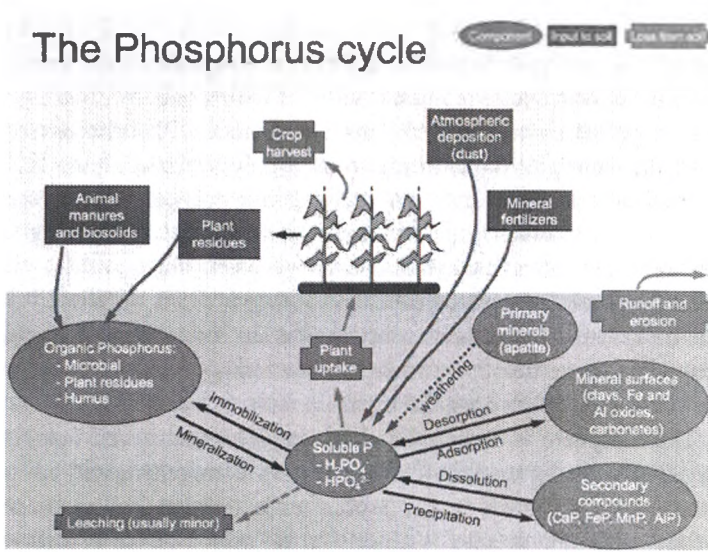


***Figure 37** - Diagram of the phosphorus circulation*

Phosphorus is found in rocks formed in past geological epochs. In the biogeochemical cycle it can get in the case of the rise of these rocks from the depths of the earth's crust to the surface of the land, to the weathering zone. Erosion processes it is carried out in the sea in the form of a well-known mineral - apatite.

The general cycle of phosphorus can be divided into two parts - water and land. In aquatic ecosystems, it is assimilated by phytoplankton and transmitted along a trophic chain up to third-order consuments - seabirds. Their excrement (guano) again fall into the sea and enter a cycle, or accumulate on the shore and washed away into the sea.

Of dead marine animals, especially fish, phosphorus again enters the sea and into the circulation, but some skeletons of fish reach great depths and the phosphorus contained in them again falls into sedimentary rocks.

In terrestrial ecosystems, phosphorus extracts plants from soils and then spreads them along the food web. Returned to the soil after the death of animals and plants and their excrement. Phosphorus from soils is lost as a result of their water erosion. The increased content of phosphorus on the waterways of its transport causes a rapid increase in the biomass of aquatic plants, the "flowering" of water bodies and their eutrophication. The greater part of phosphorus is carried away to the sea and there it is lost irrevocably.

Biogeochemical cycles are easily violated by humans. So, mining mineral fertilizers, it pollutes water and the air environment. Phosphorus enters the water, causing eutrophication, nitrogenous highly toxic compounds, etc. In other words, the cycle becomes not cyclical, but cyclical. The protection of natural resources should, in particular, be aimed at turning acyclic biogeochemical processes into cyclic ones.

Basic properties of the biosphere:

The biosphere, as well as its constituent other ecosystems of a lower rank, has a system of properties that ensure its functioning, self-regulation, stability and other parameters. Let's consider the main ones.

1. The biosphere is a centralized system. The centralized links of it are living organisms (living matter). This property is comprehensively revealed by V.I. Vernadsky, but, unfortunately, is often underestimated by man and at the present time: only one species is placed in the center of the biosphere or its links - man (anthropocentrism).

2. The biosphere is an open system. Its existence is unthinkable without the arrival of energy from without. It is affected by cosmic forces, primarily solar activity. For the first time the idea of the influence of solar activity on living organisms (heliobiology) was developed by A.L. Chizhevsky (1897-1964), who showed that many phenomena on the Earth and in the biosphere are closely related to the activity of the sun. More and more data accumulate, indicating that a sharp increase in the number of individual species or populations ("waves of life") is the result of a change in solar activity. There are

opinions that solar activity affects many geological processes (cataclysms, catastrophes), as well as the social activity of human society or its individual ethnoses.

3. The biosphere is a self-regulating system, for which, as V.I. Vernadsky noted, organization is characteristic. Now this property is called homeostasis, meaning under it the ability to return to the initial state, to quench the perturbations arising by the inclusion of a number of mechanisms. Homeostatic mechanisms are associated mainly with living matter, its properties and functions, considered above. The biosphere for history has experienced a number of such disturbances, many of which were significant in scale, and coped with them (volcanic eruptions, asteroids, earthquakes, mountain building, etc.) due to the action of homeostatic mechanisms and, in particular, the principle that at the present time it is called Le Chatelier-Brown: when the force acting on the system of forces withdrawing it from a state of stable equilibrium, the latter shifts in the direction in which the effect of this effect is weakened.

The danger of the current ecological situation is primarily due to the fact that many mechanisms of homeostasis and the Le Chatelier-Brown principle are violated, if not in planetary, or in large regional plans. Their consequence is regional crises. Fortunately, the biosphere did not seem to enter the stage of the global crisis. But it can not extinguish certain large disturbances. The result is either the disintegration of ecosystems (for example, the expanding areas of devastated lands) or the emergence of unstable, almost devoid of homeostasis properties of systems such as agrocenoses or urbanized (urban) complexes. Mankind, unfortunately, has been left out for a very short period of time so that there will not be a global crisis and the subsequent catastrophes and collapse (complete and irreversible collapse of the system).

4. The biosphere is a system characterized by great diversity. Variety is the most important property of all ecosystems. The biosphere as a global ecosystem is characterized by the greatest diversity among other systems. The latter is due to many causes and factors. These are also different environments of life (water, land-air, soil and organic); and the diversity of natural zones, differing in climatic, hydrological, soil, biotic and other properties; and the presence of regions that differ in composition (geochemical provinces); and, most importantly, the association within the biosphere of a large number of elementary ecosystems with their typical diversity.

Currently, about 2 million species are described (approximately 1.5 million animals and 0.5 million plants). It is believed, however, that the number of species on Earth is 2-3 times greater than described. Many insects and

microorganisms are not taken into account, especially in tropical forests, deep parts of the oceans and in other less developed habitats. In addition, the modern species composition is only a small part of the species diversity that took part in the biosphere processes during its existence. The fact is that each species has a certain life span (10-30 million years), and therefore, taking into account the constant change and renewal of species, the number of species that took part in the development of the biosphere is estimated at hundreds of millions. It is believed that by now the arena of the biosphere has left more than 95% of the species.

The diversity of the biosphere due to elementary ecosystems along the vertical is determined by the stratosphere or eco-horizons of the vegetation cover and associated animal organisms, and in the horizontal direction by the uneven distribution of organisms and their groupings and related factors (humidification, microrelief, provision of food, etc.)

For any natural system, diversity is one of its most important properties. It involves the possibility of duplication, backup, replacement of some links of others (for example, at the species or population levels), the degree of complexity and strength of food and other connections. Therefore, diversity is considered as the main condition for the sustainability of any ecosystem and the biosphere as a whole. This property is quite universal, which is formulated in accordance with the law (W.R. Ashby).

Unfortunately, almost without exception, human activity is subject to simplification of ecosystems of any rank. This includes the destruction of certain species or a sharp decrease in their numbers, and the creation of agrocenoses in place of complex natural systems. For example, the steppes completely disappeared from the face of the earth as a type of ecosystems and landscapes, the forest areas decreased sharply (before the appearance of man they occupied about 70% of the land, and now - no more than 20-23%). There is a further, unprecedented scale destruction of forest ecosystems at the present time, especially the most valuable and complex tropical ones, straightening river beds, creating industrial areas, etc.

Simple ecosystems with a small variety are convenient for operation, they allow a short time to obtain a significant amount of desired products (for example, from agricultural fields), but this has to be calculated by reducing the stability of ecosystems, their decay and environmental degradation.

It should be emphasized that the significance of diversity for natural systems is to a large extent valid for social structures. Any desire to simplify the

social structure of society, translate it into monotony, authoritarianism can give a short-term positive result, behind which inevitably negative consequences.

An important property of the biosphere is the presence in it of mechanisms ensuring the circulation of substances and the inexhaustibility of individual chemical elements and their compounds associated with it.

In the absence of a cycle, for example, in a short time, the basic "building material" of living carbon would be exhausted, which is practically the only one capable of forming interelement (carbon with carbon) bonds and creating a huge number of organic compounds. Only thanks to the cycles and the presence of an inexhaustible source of solar energy is provided continuity of processes in the biosphere and its potential immortality. As noted by the academician-soil scientist V.R. Williams, there is only way to make any process endless - to let him on the path of cycles. One of the most powerful anti-ecological actions of man is connected with the violation and even destruction of natural cycles.

Integrity of the biosphere as a global ecosystem

The integrity of any complex system, for example, of the organism, population, biotic communities, is a generalized characteristic of this system or object.

Biological integrity is associated with how "pristine" an environment is and its function relative to the potential or original state of an ecosystem before human alterations were imposed. Biological integrity is built on the assumption that a decline in the values of an ecosystem's functions are primarily caused by human activity or alterations. The more an environment and its original processes are altered, the less biological integrity it holds for the community as a whole. If these processes were to change over time naturally, without human influence, the integrity of the ecosystem would remain intact. The integrity of the ecosystem relies heavily on the processes that occur within it because those determine what organisms can inhabit an area and the complexities of their interactions.

The concept of biological integrity first appeared in the 1972 amendments to the U.S. Federal Water Pollution Control Act, also known as the Clean Water Act. The United States Environmental Protection Agency (EPA) had used the term as a way to gauge the standards to which water should be maintained, but the vocabulary instigated years of debate about the implications of not only the meaning of biological integrity, but also how it can be measured. The first conference about the term occurred in March 1975 called "The Integrity of

Water" and provided the first accepted definition of biological integrity (see below). In 1981, EPA assembled a field of experts from the U.S. Fish and Wildlife Service, academia, and its own staff to further refine the definition and identify key indicators to quantitatively measure biological integrity. The conference not only identified a definition, but also methods to evaluate the community, and they established that multiple sites should be used to determine the condition of the environment.

Today, the accepted definition is "the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region"

This definition was adapted from Frey (1977). The implications of this definition are that living systems have a variety of scales relative to which they exist, that one can quantify the parts that sustain or contribute to a system's functioning and that all systems must be seen in the context of their environments and evolutionary history. This term primarily refers to aquatic environments because the vocabulary is derived from the Clean Water Act, but the concepts can be applied to other ecosystems.

An example of the integrity law is the processes occurring in the ecosystems of the Atacama Desert and the adjacent part of the ocean.

The Atacama Desert lies on the west coast of South America, and its deserts are due to the cold Peruvian current (precipitation 10-50 mm/g). Cold ocean waters are rich in phyto- and zooplankton and, of course, fish, but approximately every 8-12 years from the equator the warm current of El Niño begins to spread. The arrival of these poorly oxygenated, inefficient waters leads to a catastrophic change in the ecosystem: fish (anchovies), which are caught up to 12 million tons / year, practically disappear, seabirds that feed on fish die or fly away. Especially negative impact on marine animals had El Niño in 1982: in the Galapagos Islands area, the number of birds decreased by 30-40%, the galapagos penguins decreased by 78%, and seals almost completely died.

During the same period, tropical showers are bursting over the Atacama Desert causing powerful floods, ephemeral plants and a mass of insects appear. The desert "blossoms". Such a state can last three to four or even up to five to six months, but then again, the warm current of El Niño moves back to the equator, to the Galapagos Islands, and the cold Peruvian takes its usual place. And all-natural processes develop in the opposite direction.

A study of this phenomenon for many decades has shown that it affects a much larger part of the biosphere - precipitation in Atacama leads to drought, for example, in Sudan, Ethiopia.

All this shows that when solving practical problems of rational nature management, it is necessary to take into account the law of integrity. The most striking example of non-compliance with the law of integrity is the degradation of the ecosystem of the Aral Sea area. But unlike the above example, desertification of the Aral Sea and shallowing of the Aral Sea - processes are not cyclical and not natural, but practically irreversible anthropogenic (acyclic). Such examples of global impact on the human biosphere are far from single, and as a result, anthropogenic landscapes, according to various data, occupy about half or even more than half of the land area.

The Earth's landscape envelope evolved along with the evolution of the earth's crust, but at the same time its appearance is the result of the evolution of the biosphere as a whole. It is the evolution of the biosphere that we owe to the richest variety of living nature and to the very existence of mankind.

Test tasks for self-control:

Question number 1
Biological cycle in the biosphere is provided
breeding intensity producers
the adaptation of organisms to conditions of life
the movement of substances in food chains
the struggle for existence

Q № 2
Address the issue of sustainable development contributes to the biosphere
reduction of the number of species
Earliest new species in the community
Pest Crop
elimination of environmental pollution

Q № 3
Bacteria, including in the circulation of substances in the biosphere,
participate in the formation of the ozone screen
decompose organic substances to inorganic
contribute to the formation of limestone

neutralize radioactive substances in soil
Question number 4
The main cause of instability is the ecosystem
environmental temperature swings
lack of food resources
unbalanced rotation of substances
Increased numbers of some types

Question number 5

In accordance with the concepts VI Vernadsky, to the nature of the bodies referred biokosnyh
ground
minerals
atmospheric gases
animals

Question number 6

The circulation of substances bacteria and fungi tend to act as
producers of organic substances
destroyers organic substances
initial link in the supply circuit
consuments second order

Question number 7

The greenhouse effect on earth is the result of increasing atmospheric concentrations
oxygen
carbon dioxide
sulfur dioxide
water vapor

Question number 8

The circulation of substances in the biosphere molds
destroying the organic substances to inorganic
proteins synthesized inorganic substances
digest molecular nitrogen
isolated dioxygen

Question number 9

The ecosystem of taiga first trophic level in the food chain up

spruce, larch

wild ginger, sorrel

shlyapochnye fungi, bacteria-saprotrophs

mosses, ferns

insect larvae, earthworms

putrefaction bacteria

Question number 10

the primary source of energy for the biosphere is

gamma and X-ray cosmic radiation

fusion depths in the Earth

living matter of the biosphere

the light energy of the sun

THEME 8. THE CONCEPT OF SUSTAINABLE DEVELOPMENT. ECOLOGICAL CRISIS AND PROBLEMS OF MODERN CIVILIZATION

8.1. Anthropogenic impacts as a geological and geochemical factor in the evolution of the biosphere

8.2. The seizure of natural resources. Changing of the climate. Environmental pollution

8.3. Influence of harmful and dangerous factors of production and the environment on human health

8.4. Environmental damage, ecological crisis, their manifestations at the global, regional and local levels

Anthropogenic impacts as a geological and geochemical factor of the evolution of the biosphere

The scientific and practical significance of Vernadsky's activity as the founder of the doctrine of the biosphere lies in the fact that he for the first time deeply substantiated the unity of man and the biosphere. The living matter itself as the carrier of reason, Vernadsky noted, is a small part of the biosphere by mass. The emergence of human society was the result of the prolonged development of living matter within the biosphere. The appearance of man on Earth predetermined the inevitability of the emergence of a new state of the biosphere - its transition to the noosphere, the shell of the mind, engulfed by the purposeful activity of the man himself. At the same time, a period of conscious human activity was preceded by a long period of his wild, half-savage and, in general, elemental existence

Within the biosphere originally appeared the sphere of primitive activity of human society, which is often called anthroposphere. It was initiated by the settling of a man on the entire surface of the land as a result of the use of fire.Later, a man mastered the fire and became relatively independent of the climate and settled all continents, except Antarctica. According to the evidence of unique paleontological finds, a man who originated in the wilds of Central Africa, mastered Europe, Asia, Australia, and with further improvement of his body reached the expanses of the North and South America.

In the course of development of the productive forces, the anthroposphere, encompassing the spontaneous activity of human society, must objectively go over into the noosphere - the sphere of conscious activity. In the

modern era, the formation of the noosphere is closely connected with the mastery of various forms of motion of matter - originally mechanical, then thermal, chemical, atomic-nuclear. The next step is mastering the biological forms of movement - creating living forms with the help of methods and means of biotechnology and genetic engineering. The appearance of new substances of a quality in the biosphere is connected with this.

V.I. Vernadsky, assessing the role of the human mind and scientific thought, draws the following conclusions:

1. The course of scientific creativity is the force by which a person changes the biosphere in which he lives.

2. This manifestation of the change in the biosphere is an inevitable phenomenon accompanying the growth of scientific thought.

3. This change in the biosphere occurs independently of the human volition, spontaneously, as a natural process.

4. The biosphere - is an organized shell of the planet, entering there - is a natural process of transition of the biosphere to a new phase, a new state - the noosphere.

5. In the historical moment we are experiencing, that we see it more clearly than we could see it before. Here we discover the "laws of nature". New sciences - geochemistry and biogeochemistry - provide an opportunity to first express some important features of the process mathematically.

The conclusion that the biosphere will inevitably turn into a noosphere, that is, the sphere where the human mind will play the dominant role in the development of the system "man-nature", was called the law of the noosphere of V.I. Vernadsky.

One of the successes in modern science can be considered a conscious desire to solve problems of rational use of natural resources and ensure the sustainability of the environment of life. The main thing is to develop a system of measures that would ensure the functioning of the biosphere in new conditions and the unlimited existence of mankind on the planet. Recipes of restrictive nature, nature protection measures in the strict sense of the word, are not capable of giving the desired effect. Now it is not about weakening our pressure on nature, in the hope that after this, it will recover itself. In many cases, more effective assistance is needed. The environmental protection strategy must be supported by environmental measures, because without them (natural) can the evolutionary regress.

In place of the habitual subjective-objective relationship of man to nature, a kind of "centaur" unity has come in which our former objects, nature, can not

exist without the help of the human mind. Therefore, at the moment, we are not even talking about the noosphere in the sense of V.I. Vernadsky, but about some clearly "synthetic" unity, which could be called "geo-bio-techno-noosphere." The rupture of such a unity would lead to the disintegration of its "elements" as viable objects. The process of establishing new relationships is very difficult, there is no guarantee that success lies ahead.

This will require self-organization. Work on a strategy of existence in the new conditions requires the unification of the efforts of many scientists, the integration of science with culture, philosophy, religion, social movement; but the most important is to overcome the dictates of politics and economics in the social structure over the spiritually moral principles that are incorporated as a mechanism of self-preservation in any human being. Influence on public consciousness can be stimulating the needs of man. As known, there are two spheres of consumption: production and personal.

In the manufacturing sector, some progress has recently been made. These are energy saving policies of several countries, environmental requirements for transport, etc. In addition, there is a certain shift in consciousness - the realization by society, including entrepreneurs, of the need for consumption management: the lack of study of demand, but the management of it, the process of forming a culture of production.

The sphere of personal consumption is closed by the consumption of objects and services by a person. An approximate grouping of facts that affects these needs is as follows:

1 group - Socio-historical factors (geographical position, climate, traditions and customs, the state of the natural environment);

2 group - Technical and economic factors (they characterize the degree of economic development of the region, technical and scientific potential, qualification of workers);

3 group - Socio-political factors (they are determined by the dominant form of ownership, the political structure of the state, their influence depends on the distribution of national income, social guarantees, etc.)

An analysis of all these factors speaks of the immediate needs of modern man; his worldview is closed on the chain "Man-Earth-Production" and a single picture of the world and the realization of himself as a particle of the universe is missing.

In fact, the issue of the culture of production and consumption is becoming topical. Search criteria for "reasonable needs", the formation of environmental ethics. The well-known American economist Harrington

Emerson wrote that human activity must have the same type of organization as "defensive-constructive", which exists in the world of terrestrial plants, and not military-destructive, which is actively cultivated now. Reasonable economic activity should correspond to the fact that in the world of plants corresponds to photosynthesis, and should be the same environmentally friendly, energy-balanced, which is the productive activity of green plants. The reward is the durable existence of the entire community.

Criteria for reasonable production needs are increasingly clear, with the will and desire to improve the management system; it is possible to solve many problems (the Declaration of Entrepreneurs adopted by the Rio Conference in 1992, the environmental policy of the Netherlands, the USA, Japan, and China). It is much more difficult to determine the criteria of reasonableness in the sphere of personal consumption. The majority of the population is very inert towards the calls of ecologists to take care of the future of their children and grandchildren. The rear several explanations for this narrowness of thinking:

1. The entire system of upbringing and education is oriented towards material values;

2. The ecological norms of culture are lost, national life-affirming traditions;

3. Nihilism and complete disregard for spiritual values, loss of purpose and meaning of life, disbelief in the Eternity of the world;

4. Galloping materialization of life, therefore, and dehumanization.

The formation of reasonable needs is the process of the formation of a person as a person, a step into a new civilization. Until now, it has often been argued that any moral criterion restricts the very principle of freedom in any search, restrains progress. The noospheric ideal is life; it is revered as the highest good, the spiritual goal of any activity. It is this good, such a goal and such an object that concerns everyone without exception. Therefore, regulating relationships with nature, caring and restoring it is a matter without exaggeration of everyone living. Culture, art, religion, as bearers of the moral imperative, must occupy a place that is appropriate for them in solving environmental problems of mankind. It is not enough to make a person know how to act correctly in certain circumstances, it is necessary that he cannot, by virtue of education of convictions, act differently. And if people want to preserve themselves, their nature, their kind, all the accumulation of culture, i.e. actually the whole human world, they not only need to know all the modern scientific theories, but also learn to perceive those symbols of beauty that are in

the world around us or created by man. Only with this synthesis humanity has a chance to save life.

The seizure of natural resources. Climate change. Environmental pollution.

Resource extraction and consumption. The extraction and consumption of resources has an impact on the quality of life and well-being of both current and future generations. This includes oil and gas extraction, mining, fishing and forestry.

The lack of management of natural resources leads not only to environmental problems such as land degradation, soil erosion and pollution, but it can also create serious social and economic tensions. An example of this is known as the "resource curse" where countries rich in natural resources have seen conflict, corruption and persisting high levels of poverty due to the scramble for the country's wealth. Of the 3.5 billion people who live in countries rich in oil, gas and minerals, many of them live in poverty due to poor governance and the gains not being invested in local people and communities.

Deforestation. The cutting down of forests is now estimated to contribute to nearly 20 percent of the greenhouse gases emitted into the atmosphere, making it the second highest cause of emissions after the energy sector. It is estimated that around half the world's forests have been destroyed and that if current accelerated rates continue, there will be less than 10 percent left by 2030.

The biggest causes of deforestation are to provide land for agriculture, to graze cattle and logging. In 2008 the UN launched Reduced Emissions from Deforestation and Forest Degradation Program, or UN-REDD, The Program will assess a wide range of pressing issues, including how best to counter the forces that are driving deforestation and how best to ensure that the needs of local and indigenous peoples are addressed in a post-2012 climate agreement that may include payments for standing forests.

Oil and gas industries. The world currently consumes around 85 billion barrels of oil per day, more than half of this by OECD countries. According to the most conservative estimates from the International Energy Agency that figure will rise to 113 million barrels by 2030. BP's Statistical Review of World Energy estimates that at current rates of consumption, the world's known oil reserves will be depleted within 40 years. However many scientists believe that the world's oil production has already peaked, or will do so in the next few

years. This would have a crippling effect on oil-dependent economies. Oil is used not only for fuel but to make most plastics, power farming equipment, make pesticides and fertilizers, and produce many metal products, particularly aluminum.

Natural gas is said to be one of the cleaner fossil fuels, but it is composed mostly of methane which when combusted produces carbon dioxide and contributes to global warming. However, it produces only about half as much carbon dioxide as coal. Around 21 percent of the world's energy supply comes from natural gas.

The Extractive Industries Transparency Initiative (EITI) is a coalition of governments, companies, civil society groups, investors and international organizations working together to strengthen governance by improving transparency and accountability in the extractives sector.

Solar Action Alliance is a group of environmentalists who want to spread the word about the most clean, reliable, and abundant source of renewable energy: the sun.

Climate change is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years). Climate change may refer to a change in average weather conditions, or in the time variation of weather within the context of longer-term average conditions. Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have been identified as primary causes of ongoing climate change, often referred to as global warming. The most general definition of climate change is a change in the statistical properties (principally its mean and spread) of the climate system when considered over long periods of time, regardless of cause. The term "climate change" is often used to refer specifically to anthropogenic climate change (also known as global warming). Anthropogenic climate change is caused by human activity, as opposed to changes in climate that may have resulted as part of Earth's natural processes. In this sense, especially in the context of environmental policy, the term climate change has become synonymous with anthropogenic global warming. Within scientific journals, global warming refers to surface temperature increases while climate change includes global warming and everything else that increasing greenhouse gas levels affect.

A related term is "climatic change". In 1966, the World Meteorological Organization (WMO) proposed the term "climatic change" to encompass all forms of climatic variability on time-scales longer than 10 years, regardless of

cause. Change was a given and climatic was used as an adjective to describe this kind of change (as opposed to political or economic change). When it was realized that human activities had a potential to drastically alter the climate, the term climate change replaced climatic change as the dominant term to reflect an anthropogenic cause. Climate change was incorporated in the title of the Intergovernmental Panel on Climate Change (IPCC) and the UN Framework Convention on Climate Change (UNFCCC). Climate change, used as a noun, became an issue rather than the technical description of changing weather.

On the broadest scale, the rate at which energy is received from the Sun and the rate at which it is lost to space determine the equilibrium temperature and climate of Earth. This energy is distributed around the globe by winds, ocean currents, and other mechanisms to affect the climates of different regions.

Factors that can shape climate are called climate forcing or "forcing mechanisms". These include processes such as variations in solar radiation, variations in the Earth's orbit, variations in the albedo or reflectivity of the continents, atmosphere, and oceans, mountain-building and continental drift and changes in greenhouse gas concentrations. There are a variety of climate change feedbacks that can either amplify or diminish the initial forcing. Some parts of the climate system, such as the oceans and ice caps, respond more slowly in reaction to climate forcing, while others respond more quickly. There are also keythreshold factors which when exceeded can produce rapid change.

Forcing mechanisms can be either "internal" or "external". Internal forcing mechanisms are natural processes within the climate system itself (e.g., the thermohaline circulation). External forcing mechanisms can be either natural (e.g., changes in solar output, the earth's orbit, and volcano eruptions) or anthropogenic (e.g. increased emissions of greenhouse gases and dust).

Whether the initial forcing mechanism is internal or external, the response of the climate system might be fast (e.g., a sudden cooling due to airborne volcanic ash reflecting sunlight), slow (e.g. thermal expansion of warming ocean water), or a combination (e.g., sudden loss of albedo in the Arctic Ocean as sea ice melts, followed by more gradual thermal expansion of the water). Therefore, the climate system can respond abruptly, but the full response to forcing mechanisms might not be fully developed for centuries or even longer.Internal forcing mechanisms. Scientists generally define the five components of earth's climate system to include atmosphere, hydrosphere, cryosphere, lithosphere (restricted to the surface soils, rocks, and sediments),

and biosphere. Natural changes in the climate system ("internal forcing") result in internal "climate variability". Examples include the type and distribution of species, and changes in ocean-atmosphere circulations.

Ocean-atmosphere variability. The ocean and atmosphere can work together to spontaneously generate internal climate variability that can persist for years to decades at a time. These variations can affect global average surface temperature by redistributing heat between the deep ocean and the atmosphere and/or by altering the cloud/water vapor/sea ice distribution which can affect the total energy budget of the earth. The oceanic aspects of these circulations can generate variability on centennial timescales due to the ocean having hundreds of times more mass than in the atmosphere, and thus very high thermal inertia. For example, alterations to ocean processes such as thermohaline circulation play a key role in redistributing heat in the world's oceans. Due to the long timescales of this circulation, ocean temperature at depth is still adjusting to effects of the Little Ice Age which occurred between the 1600 and 1800 s.

Orbital variations. Slight variations in Earth's orbit lead to changes in the seasonal distribution of sunlight reaching the Earth's surface and how it is distributed across the globe. There is very little change to the area-averaged annually averaged sunshine; but there can be strong changes in the geographical and seasonal distribution. The three types of orbital variations are variations in Earth's eccentricity, changes in the tilt angle of Earth's axis of rotation, and precession of Earth's axis. Combined together, these produce Milankovitch cycles which have a large impact on climate and are notable for their correlation to glacial and interglacial periods, their correlation with the advance and retreat of the Sahara and for their appearance in the stratigraphic record.

The IPCC notes that Milankovitch cycles drove the ice age cycles, CO_2 followed temperature change "with a lag of some hundreds of years", and that as a feedback amplified temperature change. The depths of the ocean have a lag time in changing temperature (thermal inertiaon such scale). Upon seawater temperature change, the solubility of CO_2 in the oceans changed, as well as other factors impacting air-sea CO_2 exchange.

Solar output. The Sun is the predominant source of energy input to the Earth. Other sources include geothermal energy from the Earth's core, tidal energy from the Moon and heat from the decay of radioactive compounds. Both long- and short-term variations in solar intensity are known to affect global climate. Three to four billion years ago, the Sun emitted only 70% as much power as it does today. If the atmospheric composition had been the same as

today, liquid water should not have existed on Earth. However, there is evidence for the presence of water on the early Earth, in the Hadean and Achaeaneons, leading to what is known as the faint young Sun paradox. Hypothesized solutions to this paradox include a vastly different atmosphere, with much higher concentrations of greenhouse gases than currently exist. Over the following approximately 4 billion years, the energy output of the Sun increased and atmospheric composition changed. The Great Oxygenation Event – oxygenation of the atmosphere around 2.4 billion years ago – was the most notable alteration. Over the next five billion years, the Sun's ultimate death as it becomes a red giant and then a white dwarf will have large effects on climate, with the red giant phase possibly ending any life on Earth that survives until that time.

Volcanism. The eruptions considered to be large enough to affect the Earth's climate on a scale of more than 1 year are the ones that inject over 100,000 tons of SO_2 into the stratosphere. This is due to the optical properties of SO_2 and sulfate aerosols, which strongly absorb or scatter solar radiation, creating a global layer of sulfuric acid haze. On average, such eruptions occur several times per century, and cause cooling (by partially blocking the transmission of solar radiation to the Earth's surface) for a period of a few years. The eruption of Mount Pinatubo in 1991, the second largest terrestrial eruption of the 20th century, affected the climate substantially, subsequently global temperatures decreased by about 0.5 C (0.9 F) for up to three years. Thus, the cooling over large parts of the Earth reduced surface temperatures in 1991–93, the equivalent to a reduction in net radiation of 4 watts per square meter. The Mount Tambora eruption in 1815 caused the Year Without a Summer. Much larger eruptions, known as large igneous provinces, occur only a few times every fifty – one hundred million years – through flood basalt, and caused in Earth past global warming and mass extinctions.Small eruptions, with injections of less than 0.1 Mt of sulfur dioxide into the stratosphere, impact the atmosphere only subtly, as temperature changes are comparable with natural variability. However, because smaller eruptions occur at a much higher frequency, they too have a significant impact on Earth's atmosphere.

Seismic monitoring maps current and future trends in volcanic activities, and tries to develop early warning systems. In climate modeling the aim is to study the physical mechanisms and feedbacks of volcanic forcing. Volcanoes are also part of the extended carbon cycle. Over very long (geological) time periods, they release carbon dioxide from the Earth's crust and mantle,

counteracting the uptake by sedimentary rocks and other geological carbon dioxide sinks. A review of published studies indicates that annual volcanic emissions of carbon dioxide, including amounts released from mid-ocean ridges, volcanic arcs, and hot spot volcanoes, are only the equivalent of 3 to 5 days of human-caused output. The annual amount put out by human activities may be greater than the amount released by super eruptions, the most recent of which was the Toba eruption in Indonesia 74,000 years ago. Although volcanoes are technically part of the lithosphere, which itself is part of the climate system, the IPCC explicitly defines volcanism as an external forcing agent

Plate tectonics. Over the course of millions of years, the motion of tectonic plates reconfigures global land and ocean areas and generates topography. This can affect both global and local patterns of climate and atmosphere-ocean circulation.

The position of the continents determines the geometry of the oceans and therefore influences patterns of ocean circulation. The locations of the seas are important in controlling the transfer of heat and moisture across the globe, and therefore, in determining global climate. A recent example of tectonic control on ocean circulation is the formation of the Isthmus of Panama about 5 million years ago, which shut off direct mixing between the Atlantic and Pacific Oceans. This strongly affected the ocean dynamics of what is now the Gulf Stream and may have led to Northern Hemisphere ice cover. During the Carboniferous period, about 300 to 360 million years ago, plate tectonics may have triggered large-scale storage of carbon and increased glaciation. Geologic evidence points to a "megamonsoonal" circulation pattern during the time of the supercontinent Pangaea, and climate modeling suggests that the existence of the supercontinent was conducive to the establishment of monsoons.

The size of continents is also important. Because of the stabilizing effect of the oceans on temperature, yearly temperature variations are generally lower in coastal areas than they are inland. A larger supercontinent will therefore have more area in which climate is strongly seasonal than will several smaller continents or islands.

Human influences. In the context of climate variation, anthropogenic factors are human activities which affect the climate. The scientific consensus on climate change is "that climate is changing and that these changes are in large part caused by human activities," and it "is largely irreversible."

"Science has made enormous inroads in understanding climate change and its causes, and is beginning to help develop a strong understanding of current and potential impacts that will affect people today and in coming decades. This understanding is crucial because it allows decision makers to place climate change in the context of other large challenges facing the nation and the world. There are still some uncertainties, and there always will be in understanding a complex system like Earth's climate. Nevertheless, there is a strong, credible body of evidence, based on multiple lines of research, documenting that climate is changing and that these changes are in large part caused by human activities. While much remains to be learned, the core phenomenon, scientific questions, and hypotheses have been examined thoroughly and have stood firm in the face of serious scientific debate and careful evaluation of alternative explanations."

Of most concern in these anthropogenic factors is the increase in CO_2 levels. This is due to emissions from fossil fuel combustion, followed by aerosols (particulate matter in the atmosphere), and the CO_2 released by cement manufacture. Other factors, including land use, ozone depletion, animal husbandry (ruminant animals such as cattle produce methane, as do termites), and deforestation, are also of concern in the roles they play – both separately and in conjunction with other factors – in affecting climate, microclimate, and measures of climate variables.

Evidence for climatic change is taken from a variety of sources that can be used to reconstruct past climates. Reasonably complete global records of surface temperature are available beginning from the mid-late 19th century. For earlier periods, most of the evidence is indirect—climatic changes are inferred from changes in proxies, indicators that reflect climate, such as vegetation, ice cores, dendrochronology, sea level change, and glacial geology.

Arctic sea ice loss. The decline in Arctic sea ice, both in extent and thickness, over the last several decades is further evidence for rapid climate change. Sea ice is frozen seawater that floats on the ocean surface. It covers millions of square kilometers in the polar regions, varying with the seasons. In the Arctic, some sea ice remains year after year, whereas almost all Southern Ocean or Antarctic sea ice melts away and reforms annually. Satellite observations show that Arctic sea ice is now declining at a rate of 13.3 percent per decade, relative to the 1981 to 2010 average. The 2007 Arctic summer sea ice retreat was unprecedented. Decades of shrinking and thinning in a warm climate has put the Arctic sea ice in a precarious position, it is now vulnerable to atmospheric anomalies. "Both extent and volume anomaly fluctuate little

from January to July and then decrease steeply in August and September". This decrease is because of lessened ice production as a result of the unusually high SAT. During the Arctic summer, a slower rate of sea ice production is the same as a faster rate of sea ice melting.

Vegetation. A change in the type, distribution and coverage of vegetation may occur given a change in the climate. Some changes in climate may result in increased precipitation and warmth, resulting in improved plant growth and the subsequent sequestration of airborne CO_2. A gradual increase in warmth in a region will lead to earlier flowering and fruiting times, driving a change in the timing of life cycles of dependent organisms. Conversely, cold will cause plant bio-cycles to lag. Larger, faster or more radical changes, however, may result in vegetation stress, rapid plant loss and desertification in certain circumstances. An example of this occurred during the Carboniferous Rainforest Collapse (CRC), an extinction event 300 million years ago. At this time vast rainforests covered the equatorial region of Europe and America. Climate change devastated these tropical rainforests, abruptly fragmenting the habitat into isolated 'islands' and causing the extinction of many plant and animal species.

Forest genetic resources. Even though this is a field with many uncertainties, it is expected that over the next 50 years climate changes will have an effect on the diversity of forest genetic resources and thereby on the distribution of forest tree species and the composition of forests. Diversity of forest genetic resources enables the potential for a species (or a population) to adapt to climatic changes and related future challenges such as temperature changes, drought, pests, diseases and forest fire. However, species are not naturally capable to adapt in the pace of which the climate is changing and the increasing temperatures will most likely facilitate the spread of pests and diseases, creating an additional threat to forest trees and their populations. To inhibit these problems human interventions, such as transfer of forest reproductive material, may be needed.

Cloud cover and precipitation. Past precipitation can be estimated in the modern era with the global network of precipitation gauges. Surface coverage over oceans and remote areas is relatively sparse, but, reducing reliance on interpolation, satellite clouds and precipitation data has been available since the 1970s. Quantification of climatological variation of precipitation in prior centuries and epochs is less complete but approximated using proxies such as marine sediments, ice cores, cave stalagmites, and tree rings. In July 2016 scientists published evidence of increased cloud cover over polar regions, as predicted by climate models. Climatological temperatures substantially affect

cloud cover and precipitation. For instance, during the Last Glacial Maximum of 18,000 years ago, thermal-driven evaporation from the oceans onto continental landmasses was low, causing large areas of extreme desert, including polar deserts (cold but with low rates of cloud cover and precipitation). In contrast, the world's climate was cloudier and wetter than today near the start of the warm Atlantic Period of 8000 years ago.

Dendroclimatology. Dendroclimatology is the analysis of tree ring growth patterns to determine past climate variations. Wide and thick rings indicate a fertile, well-watered growing period, while thin, narrow rings indicate a period of lower rainfall and less-than-ideal growing conditions.

Ice cores. Analysis of ice in a core drilled from an ice sheet such as the Antarctic ice sheet, can be used to show a link between temperature and global sea level variations. The air trapped in bubbles in the ice can also reveal the CO_2 variations of the atmosphere from the distant past, well before modern environmental influences. The study of these ice cores has been a significant indicator of the changes in CO_2 over many millennia, and continues to provide valuable information about the differences between ancient and modern atmospheric conditions.

Animals. Remains of beetles are common in freshwater and land sediments. Different species of beetles tend to be found under different climatic conditions. Given the extensive lineage of beetles whose genetic makeup has not altered significantly over the millennia, knowledge of the present climatic range of the different species, and the age of the sediments in which remains are found, past climatic conditions may be inferred. The studies of the impact in vertebrates are few mainly from developing countries, where there are the fewest studies; between 1970 and 2012, vertebrates declined by 58 percent, with freshwater, marine, and terrestrial populations declining by 81, 36, and 35 percent, respectively.

Similarly, the historical abundance of various fish species has been found to have a substantial relationship with observed climatic conditions. Changes in the primary productivity of autotrophs nin the oceans can affect marine food webs.

Sea level change. Global sea level change for much of the last century has generally been estimated using tide gauge measurements collated over long periods of time to give a long-term average. More recently, altimeter measurements — in combination with accurately determined satellite orbits - have provided an improved measurement of global sea level change. To measure sea levels prior to instrumental measurements, scientists have dated

coral reefs that grow near the surface of the ocean, coastal sediments, marine terraces, **ooids** in limestone's, and nearshore archaeological remains. The predominant dating methods used are uranium series and radiocarbon, with cosmogenic radionuclide's being sometimes used to date terraces that have experienced relative sea level fall. In the early Pliocene, global temperatures were 1–2°C warmer than the present temperature, yet sea level was 15–25 meters higher than today.

Influence of harmful and dangerous factors of production and the environment on human health

This brief account can address only a small part of a vast and expanding subject. The environment in which we live can be considered as having three fundamental sets of components:

- Physical [energy of one form or another]
- Chemical [matter i.e. substances whether natural or man-made]
- Biological [living things].

Hazards can present themselves to us in various media e.g. air, water. The influence they can exert on our health is very complex and may be modulated by our genetic makeup, psychological factors and by our perceptions of the risks that they present. The following deals with general environmental health hazards, and not extremes of climate, occupational hazards, hazards associated with food, most "accidents" or sexually transmitted disease. Health effects from economic and social consequences of environmental change are also not considered here.

Associations between an exposure and an adverse health effect do not, on their own, prove that the former is the cause of the latter. Many other non-causal associations could explain the findings. These concerns explain why the language in this context may well be "hedged" even though you might have formed impressions from other sources that some postulated causal associations had been proven.

Physical Hazards, and their Adverse Health Effects. Although you will have heard or read a great deal about the environmental consequences of global warming, man will probably be affected through famine, or war long before the health of the population as a whole is harmed to a serious degree by the temperature change. However increasing extremes of temperature, as a result of climatic change, could result in increased mortality even in temperate climates.

Important issues concerning physical hazards include those relating to health effects of electromagnetic radiation and ionizing radiation. If one excludes the occupational environment, then noise and other physical hazards may present a nuisance to many inhabitants, and impair general well being. Environmental noise does not usually contribute to deafness but notable exceptions may include noisy discotheques and "personal stereos".

Electromagnetic radiation ranges from low frequency, relatively low energy, radiation such as radio and microwaves through to infra red, visible light, ultraviolet, X-rays and gamma rays. These last as well as other forms of radioactivity such as high energy subatomic particles (e.g. electrons - Beta rays) can cause intracellular ionization and are therefore called ionizing radiation. Exposure to ultraviolet (UV) radiation carries a increased risk of skin cancer such as melanoma, and of cataracts which are to an extent exposure related. Some pollutants such as chlorofluorocarbons (CFCs) used as refrigerants or in aerosol propellants or in the manufacture of certain plastics can damage the "ozone layer" in the higher atmosphere (stratosphere) and thus allow more UV light to reach us, and harm us directly. Ultraviolet light may also cause harm indirectly by contributing to an increase in ozone in the troposphere (the air we breathe) - see below under chemical hazards, or elsewhere in connection with air quality.

Radioactivity is associated with an exposure dependent risk of some cancers notably leukemia. Contrary to popular belief however, most radiation to which the average person is exposed is natural in origin, and, of the man made sources, medical diagnosis and treatment is on average the largest source to the individual. A very important issue is the extent to which radon gas arising from certain rock types beneath dwellings can contribute to cancer risk. According to some estimates it could result in a few thousand cancer deaths per year in the U.K. (but still probably less than one twentieth of the cancer deaths alone caused by tobacco smoking).

Ionizing radiation from the nuclear industry and from fallout from detonations contributes less than 1% of the annual average dose to inhabitants of the U.K. The explanation for leukemia clusters around nuclear power plants is not yet resolved. Similar clustering can occur in other parts of the country. The effect of viral infections associated with population shifts may be important but requires further study.

No ionizing electrical, magnetic or electromagnetic fields are an increasing focus of attention. The scientific evidence of adverse health effects

from general environmental exposure to these fields is "not proven". If there are adverse effects yet to be proven, the risk is probably likely to be very small.

Chemical Hazards, and their Adverse Health Effects. If one includes tobacco smoke as an environmental hazard then it probably represents the single biggest known airborne chemical risk to health, whether measured in terms of death rates or ill-health (from lung cancer, other lung disease such as chronic bronchitis and emphysema, and disease of the heart, especially, and of blood vessels and other parts of the body). To a much lesser degree of risk, these adverse effects apply to non-smokers exposed passively to side stream tobacco smoke.

General airborne pollution arises from a variety of causes but can usefully be subdivided into pollution from combustion or from other sources. The image shows the silhouette of a power station - an important source of airborne products of combustion.

Combustion of coal and other solid fuels can produce smoke (containing polycyclic aromatic hydrocarbons - PAH) and sulphur dioxide besides other agents such as those also produced by:

Combustion of liquid petroleum products which can generate carbon monoxide, oxides of nitrogen and other agents. Industry and incineration can generate a wide range of products of combustion such as oxides of sulphur and nitrogen, polycyclic aromatic hydrocarbons, dioxins etc. Combustion of any fossil fuel generates varying amounts of particulate matter. It also adds to the environmental burden of carbon dioxide - an important "green house" gas but in these low concentrations it does not affect human health directly. Combustion of fuel can also generate hazardous substances in other ways, besides by chemical oxidation, such as by liberating benzene (from the "cracking" of petrol) or lead (from leaded petrol). Some of the primary pollutants such as nitrogen dioxide can, under the influence of UV light generate secondary pollutants notably ozone (an allotrope of oxygen).Find out more about air quality in relation to these substances.

Undoubtedly tens of thousands of deaths have resulted from acute pollution episodes (e.g. the smog's in large cities in the early 1950s). Nowadays some people e.g. asthmatics can be adversely affected by excursions in levels of urban air pollution (notably ozone) in some major cities. What is still unclear is the extent to which urban airborne pollution in the majority of cities complying with current air quality guidelines, contributes to ill health, i.e. whether the air quality guidelines are stringent enough, to protect all the population.

Health effects of concern are asthma, bronchitis and similar lung diseases, and there is good evidence relating an increased risk of symptoms of these diseases with increasing concentration of sulphur dioxide, ozone and other pollutants. Moreover, there is increasing evidence to suggest that pollution from particulate matter at levels hitherto considered "safe" is associated with an increased risk of morbidity and mortality from cardiopulmonary disease especially in people with other risk factors (such as old age, or heart and lung disease). These concerns are the subject of a great deal of research throughout the world. Although high occupational exposures to exhaust especially from diesel, and to benzene does increase the risk of some cancers, reliable direct evidence of an increased to cancer risk to the population at large from the lower levels to which they are exposed is lacking.

Incineration can also generate hazardous substances if substances not best suited for disposal by incineration are "disposed" of in this way or if incineration is carried out at too low a temperature (for example this may generate dioxins).

Products of combustion and other harmful airborne pollutants can also arise within the home. Thus nitrogen dioxide generated by gas fires or gas cookers can contribute to an increased respiratory morbidity of those living in the houses. Certain modern building materials may liberate gases or vapours such as formaldehyde at low concentration but which might provoke mild respiratory and other symptoms in some occupants. Modern building standards for asbestos in buildings are such that the resulting airborne fibre concentrations are so small as not to present any risk at all of asbestosis. However some estimates suggest that perhaps one extra death per year might result in the UK from asbestos related cancer as a result of non-occupational exposure in buildings. The image shows an asbestos body i.e. an asbestos fibre which has been coated by ferruginous protein during its residence within the human lung.

Large scale industrial releases with serious acute effects are fortunately rare but you might recollect some events such as in Bhopal (India). Various smaller scale events occur such as leaks from road tankers, or fires in warehouses and factories. Special local environmental exposures can arise for example in communities exposed to drifting pesticide sprays containing say, organophosphates. Some natural phenomena such as volcanic eruptions can present serious risks to health. Fortunately they are rare but can be catastrophic.

Water can be an important source of chemical hazards. It can leach lead from pipes especially if the water is soft. There is good epidemiological evidence that this can have a relatively small but measurable harmful effect

especially on neurological function even at levels hitherto considered "acceptable". Other adverse effects can arise from chemicals added to the water.

Chlorination of water has probably saved millions of lives (see biological hazards). Some concern has been raised about possible increased cancer risks in association with chlorinated water but there is as yet no proof that a causal association between the two exists. Fluoride added to water reduces the risks of caries but can also have unwanted effects such as mottling of the teeth.

Nitrate in water usually arising from fertilizer leaching (natural or artificial) can increase the risk of methaemoglobinaemia ('blue babies') in bottle fed infants but this is extremely rare. Although pesticides can and do leach into water, there is no evidence that the current standards for water quality are inadequate in this respect, but most standards are based on evidence other than human epidemiology which in this context is extremely difficult to conduct.

Beyond the point of supply further problems in drinking water quality may result. Thus for example water tanks containing lead may increase the burden of this metal in the water, while water softeners may increase its sodium content (can be harmful for bottle fed infants).

Deposition of solid hazardous waste can result in harmful substances leaching into water supplies, becoming airborne or being swallowed or otherwise absorbed directly (for example because of children playing on the sites). If the sites are well contained to prevent leaching into water supplies and segregated from human activity then the risk to human health is usually immeasurably small. However where the position of disposal sites and their contents are unknown and houses are proposed to be built on them or they are to be developed in other ways, extensive prior investigation may be needed in an attempt to estimate health risks.

Biological Hazards, and their Adverse Health Effects. These generally fall into two broad categories: those which produce adverse health effects through infection and those which produce adverse effects in non-infective (allergic) ways.

As regards microbiological hazards in water, substantial improvements in the health of the population have resulted historically from the supply of drinking water free from disease causing organisms such as cholera. Similar improvements can be expected in the health of the inhabitants of developing countries if microbiologically safe water is provided by avoidance of contamination, and appropriate purification including disinfection (usually by

chlorination). Occasional outbreaks of waterborne infection still arise from contamination of drinking water by soiled water (usually coliforms).

There can be other opportunities for further bacteriological contamination. Thus Legionella can grow in sumps or dead legs in the plumbing system and may then be dispersed as aerosols from showers.

Recreational water which is heavily contaminated with pathogens, notably coliform bacteria has been shown to be associated with an increased risk of gastrointestinal and other infectious illness, usually self-limiting.

So-called "clinical" waste is not merely an occupational hazard of health care workers but is becoming an increasingly more important risk, for example for children finding blood stained needles.

Many allergens such as grass pollen grains, or faecal material from house dust mites may cause attacks of asthma or "hay fever" (allergic rhinitis). There is evidence that high exposure to these allergens early in life, increases the risk of suffering from asthma later on. An increasing number of studies suggest that airborne chemical pollution can act synergistically with naturally occurring allergens and result in effects on lung function at concentrations lower than those at which either the allergen or the chemical irritant on its own would have produced an adverse effect.

Environmental damage, ecological crisis, their manifestations at the global, regional and local levels.

Environmental degradation is the disintegration of the earth or deterioration of the environment through consumption of assets, for example, air, water and soil; the destruction of environments and the eradication of wildlife. It is characterized as any change or aggravation to nature's turf seen to be pernicious or undesirable. Ecological effect or degradation is created by the consolidation of an effectively substantial and expanding human populace, constantly expanding monetary development or per capita fortune and the application of asset exhausting and polluting technology. It occurs when earth's natural resources are depleted and environment is compromised in the form of extinction of species, pollution in air, water and soil, and rapid growth in population.

Environmental degradation is one of the largest threats that are being looked at in the world today. The United Nations International Strategy for Disaster Reduction characterizes environmental degradation as the lessening of the limit of the earth to meet social and environmental destinations, and needs. Environmental degradation can happen in a number of ways. At the point when environments are wrecked or common assets are exhausted, the environment is

considered to be corrupted and harmed. There are a number of different techniques that are being used to prevent this, including environmental resource protection and general protection efforts.

Environmental issues can be seen by long term ecological effects, some of which can demolish whole environments. An environment is a unique unit and incorporates all the living and non-living components that live inside it. Plants and creatures are evident parts of the environment, but it also includes the things on which they depend on, for example, streams, lakes, and soils.

Environmental surroundings get to be divided when technological advancement splits up areas of land. Some examples of this can include streets which may slice through woods or even trails which wind through prairies. While it may not sound all terrible on the surface, there are bad results. The biggest of these results are felt by particular animal and plant groups, the vast majority of which are specific for their bio-region or need a large area in order to make sure that their genetic lines are kept intact.

Some environmental life species require substantial areas to help provide food, living space, and other different assets. These creatures are called area specific. At the point when the biome is divided, the vast patches of living space don't exist anymore. It gets to be more troublesome for the wildlife to get the assets they need in order to survive. The environment goes on, even though the animals and plant life are not there to help sustain it properly.

1. Land Disturbance: A more basic cause of environmental degradation is land damage. Numerous weedy plant species, for example, garlic mustard, are both foreign and obtrusive. A rupture in the environmental surroundings provides for them a chance to start growing and spreading. These plants can assume control over nature, eliminating the local greenery. The result is territory with a solitary predominant plant which doesn't give satisfactory food assets to all the environmental life. Whole environments can be destroyed because of these invasive species.

2. Pollution: Pollution, in whatever form, whether it is air, water, land or noise is harmful for the environment. Air pollution pollutes the air that we breathe which causes health issues. Water pollution degrades the quality of water that we use for drinking purposes. Land pollution results in degradation of earth's surface as a result of human activities. Noise pollution can cause irreparable damage to our ears when exposed to continuous large sounds like honking of vehicles on a busy road or machines producing large noise in a factory or a mill.

3. Overpopulation: Rapid population growth puts strain on natural resources which results in degradation of our environment. Mortality rate has gone down due to better medical facilities which has resulted in increased lifespan. More population simple means more demand for food, clothes and shelter. You need more space to grow food and provide homes to millions of people. This results in deforestation which is another factor of environmental degradation.

4. Landfills: Landfills pollute the environment and destroy the beauty of the city. Landfills come within the city due the large amount of waste that gets generated by households, industries, factories and hospitals. Landfills pose a great risk to the health of the environment and the people who live there. Landfills produce foul smell when burned and cause huge environmental degradation.

5. Deforestation: Deforestation is the cutting down of trees to make way for more homes and industries. Rapid growth in population and urban sprawl are two of the major causes of deforestation. Apart from that, use of forest land for agriculture, animal grazing, harvest for fuel wood and logging are some of the other causes of deforestation. Deforestation contributes to global warming as decreased forest size puts carbon back into the environment.

6: Natural Causes: Things like avalanches, quakes, tidal waves, storms, and wildfires can totally crush nearby animal and plant groups to the point where they can no longer survive in those areas. This can either come to fruition through physical demolition as the result of a specific disaster, or by the long term degradation of assets by the presentation of an obtrusive foreign species to the environment. The latter frequently happens after tidal waves, when reptiles and bugs are washed ashore.

Of course, humans aren't totally to blame for this whole thing. Earth itself causes ecological issues, as well. While environmental degradation is most normally connected with the things that people do, the truth of the matter is that the environment is always changing. With or without the effect of human exercises, a few biological systems degrade to the point where they can't help the life that is supposed to live there.

Effects of Environmental Degradation

1. Impact on Human Health: Human health might be at the receiving end as a result of the environmental degradation. Areas exposed to toxic air pollutants can cause respiratory problems like pneumonia and asthma. Millions of people are known to have died of due to indirect effects of air pollution.

2. Loss of Biodiversity: Biodiversity is important for maintaining balance of the ecosystem in the form of combating pollution, restoring nutrients, protecting water sources and stabilizing climate. Deforestation, global warming, overpopulation and pollution are few of the major causes for loss of biodiversity.

3. Ozone Layer Depletion: Ozone layer is responsible for protecting earth from harmful ultraviolet rays. The presence of chlorofluorocarbons, hydro chlorofluorocarbons in the atmosphere is causing the ozone layer to deplete. As it will deplete, it will emit harmful radiations back to the earth.

4. Loss for Tourism Industry: The deterioration of environment can be a huge setback for tourism industry that rely on tourists for their daily livelihood. Environmental damage in the form of loss of green cover, loss of biodiversity, huge landfills, increased air and water pollution can be a big turn off for most of the tourists.

5. Economic Impact: The huge cost that a country may have to borne due to environmental degradation can have big economic impact in terms of restoration of green cover, cleaning up of landfills and protection of endangered species. The economic impact can also be in terms of loss of tourism industry.

As you can see, there are a lot of things that can have an effect on the environment. If we are not careful, we can contribute to the environmental degradation that is occurring all around the world. We can, however, take action to stop it and take care of the world that we live in by providing environmental education to the people which will help them pick familiarity with their surroundings that will enable to take care of environmental concerns thus making it more useful and protected for our children and other future generations.

Test tasks for self-control:

1. The biological mechanisms of human adaptation to the environment are:

A) Immunological
B) Physical
C) Historical
D) Mathematical
E) Chemical

2. anthropoecology predominant interest:

A) Human Physiology

B) Chemistry
C) Art History
D) The main stages of the formation of social ecology
E) Biology

3. Main characteristics and patterns of development of systems:

A) Biochemical Properties
B) The principle of requisite variety of elements
C) Biological properties
D) Chemical properties
E) Physical Properties
F) Physiological properties

4. Natural (natural) ecosystems - is:

A) Sea
B) fish ponds
C) Gardens
D) Industrial plants
E) Farmland
F) Cities

5. The first scholars to formulate the law of social ecology:

A) F.Izmerov
B) I.Sechenov
C) NF Reimers
D) V.Vinogradov
E) P.Ivanov
F) P.Anohin

6. American ecologist B.Kommoner based on generalizations formulated the following set of "environmental laws":

A) Laws theoretical environmental impact
B) Everything is connected with everything
C) Human needs some social and ecologically interchangeable.
D) Act biogenic maximum energy
E) All must go somewhere

7. Laws Commoner:

A) 10% Act
B) The law of competitive exclusion
C) Law of Polarity
D) All associated with all
E) Nature knows best

8. Food security - is:

A) The crisis of relations between society and nature, to preserve the environment

B) Among the elements that can have a direct or indirect impact on living organisms

C) The situation in which all people at any time, have physical and economic access to sufficient quantitatively safe food needed for an active and healthy life

D) The totality of human activity impacts on the environment

E) The autonomy and economic independence of the national food system

9. Ambient person - the aggregate of:

A) Biotic medium

B) Information medium

C) environment Legal

D) Social media

E) The legal environment

F) of the internal environment

10. World Religions:

A) Shinto

B) Sighizm

C) Jewish

D) Buddhist

E) Christianity

F) Hinduism

THEME 9. STRATEGY, GOALS AND PRINCIPLES OF SUSTAINABLE DEVELOPMENT

9.1. Evolution of views on sustainable development and environmental security

9.2. Sustainable development factors: ecological, economic, social

9.3. Strategy, goals and principles of sustainable development. The concept of sustainable development, its principles

9.4. Implementation of the concept of sustainable development at various levels: global, regional and national

Sustainable development is the organizing principle for meeting human development goals while at the same time sustaining the ability of natural systems to provide the natural resources and ecosystem services upon which the economy and society depend. The desired result is a state of society where living and conditions and resource use continue to meet human needs without undermining the integrity and stability of the natural systems.

While the modern concept of sustainable development is derived mostly from the 1987 Brundtland Report, it is also rooted in earlier ideas about sustainable forest management and twentieth century environmental concerns. As the concept developed, it has shifted to focus more on economic development, social development and environmental protection for future generations. It has been suggested that "the term "sustainability" should be viewed as humanity's target goal of human-ecosystem equilibrium (homeostasis), while "sustainable development" refers to the holistic approach and temporal processes that lead us to the end point of sustainability".

The concept of sustainable development has been - and still is - subject to criticism. What, exactly, is to be sustained in sustainable development? It has been argued that there is no such thing as a sustainable use of a non-renewable resource, since any positive rate of exploitation will eventually lead to the exhaustion of earth's finite stock. This perspective renders the industrial revolution as a whole unsustainable. It has also been argued that the meaning of the concept has opportunistically been stretched from "conservation management" to "economic development", and that the Brundtland Report promoted nothing but a business as usual strategy for world development, with an ambiguous and insubstantial concept attached as a public relations slogan.

Since the Brundtland Report, the concept of sustainable development has developed beyond the initial intergenerational framework to focus more on the goal of "socially inclusive and environmentally sustainable economic growth". In 1992, the UN Conference on Environment and Development published the Earth Charter, which outlines the building of a just, sustainable, and peaceful global society in the 21st century. The action plan Agenda 21 for sustainable development identified information, integration, and participation as key building blocks to help countries achieve development that recognises these interdependent pillars. It emphasises that in sustainable development everyone is a user and provider of information. It stresses the need to change from old sector-centered ways of doing business to new approaches that involve cross-sectoral co-ordination and the integration of environmental and social concerns into all development processes. Furthermore, Agenda 21 emphasizes that broad public participation in decision making is a fundamental prerequisite for achieving sustainable development.

Under the principles of the United Nations Charter the Millennium Declaration identified principles and treaties on sustainable development, including economic development, social development and environmental protection. Broadly defined, sustainable development is a systems approach to growth and development and to manage natural, produced, and social capital for the welfare of their own and future generations. The term sustainable development as used by the United Nations incorporates both issues associated with land development and broader issues of human development such as education, public health, and standard of living.

A 2013 study concluded that sustainability reporting should be reframed through the lens of four interconnected domains: ecology, economics, politics and culture.

In September 2015, the United Nations General Assembly formally adopted the "universal, integrated and transformative" 2030 Agenda for Sustainable Development, a set of 17 Sustainable Development Goals (SDGs). The goals are to be implemented and achieved in every country from the year 2016 to 2030.

Sustainable development, or sustainability, has been described in terms of three spheres, dimensions, domains or pillars, i.e. the environment, the economy and society. The three-sphere framework was initially proposed by the economist René Passet in 1979. It has also been worded as "economic, environmental and social" or "ecology, economy and equity". This has been expanded by some authors to include a fourth pillar of culture, institutions or

governance, or alternatively reconfigured as four domains of the social - ecology, economics, politics and culture, thus bringing economics back inside the social, and treating ecology as the intersection of the social and the natural.

The ecological stability of human settlements is part of the relationship between humans and their natural, social and built environments. Also termed human ecology, this broadens the focus of sustainable development to include the domain of human health. Fundamental human needs such as the availability and quality of air, water, food and shelter are also the ecological foundations for sustainable development; addressing public health risk through investments in ecosystem services can be a powerful and transformative force for sustainable development which, in this sense, extends to all species.

Environmental sustainability concerns the natural environment and how it endures and remains diverse and productive. Since natural resources are derived from the environment, the state of air, water, and the climate are of particular concern. The IPCC Fifth Assessment Report outlines current knowledge about scientific, technical and socio-economic information concerning climate change, and lists options for adaptation and mitigation. Environmental sustainability requires society to design activities to meet human needs while preserving the life support systems of the planet. This, for example, entails using water sustainably, utilizing renewable energy, and sustainable material supplies (e.g. harvesting wood from forests at a rate that maintains the biomass and biodiversity).

An unsustainable situation occurs when natural capital (the sum total of nature's resources) is used up faster than it can be replenished. Sustainability requires that human activity only uses nature's resources at a rate at which they can be replenished naturally. Inherently the concept of sustainable development is intertwined with the concept of carrying capacity. Theoretically, the long-term result of environmental degradation is the inability to sustain human life. Such degradation on a global scale should imply an increase in human death rate until population falls to what the degraded environment can support. If the degradation continues beyond a certain tipping point or critical threshold it would lead to eventual extinction for humanity.

Integral elements for a sustainable development are research and innovation activities. A telling example is the European environmental research and innovation policy, which aims at defining and implementing a transformative agenda to greening the economy and the society as a whole so to achieve a truly sustainable development. Research and innovation in Europe is financially supported by the program Horizon 2020, which is also open to

participation worldwide. A promising direction towards sustainable development is to design systems that are flexible and reversible.

Pollution of the public resources is really not a different action; it just is a reverse tragedy of the commons, in that instead of taking something out, something is put into the commons. When the costs of polluting the commons are not calculated into the cost of the items consumed, then it becomes only natural to pollute, as the cost of pollution is external to the cost of the goods produced and the cost of cleaning the waste before it is discharged exceeds the cost of releasing the waste directly into the commons. So, the only way to solve this problem is by protecting the ecology of the commons by making it, through taxes or fines, more costly to release the waste directly into the commons than would be the cost of cleaning the waste before discharge.

So, one can try to appeal to the ethics of the situation by doing the right thing as an individual, but in the absence of any direct consequences, the individual will tend to do what is best for the person and not what is best for the common good of the public. Once again, this issue needs to be addressed. Because, left unaddressed, the development of the commonly owned property will become impossible to achieve in a sustainable way. So, this topic is central to the understanding of creating a sustainable situation from the management of the public resources that are used for personal use.

Sustainable agriculture consists of environment friendly methods of farming that allow the production of crops or livestock without damage to human or natural systems. It involves preventing adverse effects to soil, water, biodiversity, surrounding or downstream resources - as well as to those working or living on the farm or in neighboring areas. The concept of sustainable agriculture extends intergenerationally, passing on a conserved or improved natural resource, biotic, and economic base rather than one which has been depleted or polluted. Elements of sustainable agriculture include permaculture, agroforestry, mixed farming, multiple cropping, and crop rotation. It involves agricultural methods that do not undermine the environment, smart farming technologies that enhance a quality environment for humans to thrive and reclaiming and transforming deserts into farmlands (Herman Daly, 2017).

Numerous sustainability standards and certification systems exist, including organic certification, Rainforest Alliance, Fair Trade, UTZ Certified, Bird Friendly, and the Common Code for the Coffee Community (4C).

It has been suggested that because of rural poverty and overexploitation, environmental resources should be treated as important economic assets, called natural capital. Economic development has traditionally required a growth in

the gross domestic product. This model of unlimited personal and GDP growth may be over. Sustainable development may involve improvements in the quality of life for many but may necessitate a decrease in resource consumption. According to ecological economist Malte Faber, ecological economics is defined by its focus on nature, justice, and time. Issues of intergenerational equity, irreversibility of environmental change, uncertainty of long-term outcomes, and sustainable development guide ecological economic analysis and valuation.

As early as the 1970s, the concept of sustainability was used to describe an economy "in equilibrium with basic ecological support systems". Scientists in many fields have highlighted The Limits to Growth, and economists have presented alternatives, for example a "steady-state economy"; to address concerns over the impacts of expanding human development on the planet. In 1987 the economist Edward Barbier published the study The Concept of Sustainable Economic Development, where he recognised that goals of environmental conservation and economic development are not conflicting and can be reinforcing each other.

A meta review in 2002 looked at environmental and economic valuations and found a lack of "sustainability policies". A study in 2004 asked if we consume too much. A study concluded in 2007 that knowledge, manufactured and human capital (health and education) has not compensated for the degradation of natural capital in many parts of the world. It has been suggested that intergenerational equity can be incorporated into a sustainable development and decision making, as has become common in economic valuations of climate economics. A meta review in 2009 identified conditions for a strong case to act on climate change, and called for more work to fully account of the relevant economics and how it affects human welfare. According to free-market environmentalist John Baden "the improvement of environment quality depends on the market economy and the existence of legitimate and protected property rights". They enable the effective practice of personal responsibility and the development of mechanisms to protect the environment. The State can in this context "create conditions which encourage the people to save the environment". The total environment includes not just the biosphere of earth, air, and water, but also human interactions with these things, with nature, and what humans have created as their surroundings.

As countries around the world continue to advance economically, they put a strain on the ability of the natural environment to absorb the high level of pollutants that are created as a part of this economic growth. Therefore,

solutions need to be found so that the economies of the world can continue to grow, but not at the expense of the public good. In the world of economics the amount of environmental quality must be considered as limited in supply and therefore is treated as a scarce resource. This is a resource to be protected. One common way to analyze possible outcomes of policy decisions on the scarce resource is to do a cost-benefit analysis. This type of analysis contrasts different options of resource allocation and, based on an evaluation of the expected courses of action and the consequences of these actions, the optimal way to do so in the light of different policy goals can be elicited.

Benefit-cost analysis basically can look at several ways of solving a problem and then assigning the best route for a solution, based on the set of consequences that would result from the further development of the individual courses of action, and then choosing the course of action that results in the least amount of damage to the expected outcome for the environmental quality that remains after that development or process takes place. Further complicating this analysis are the interrelationships of the various parts of the environment that might be impacted by the chosen course of action. Sometimes it is almost impossible to predict the various outcomes of a course of action, due to the unexpected consequences and the amount of unknowns that are not accounted for in the benefit-cost analysis.

Sustainable energy is clean and can be used over a long period of time. Unlike fossil fuels and biofuels that provide the bulk of the worlds energy, renewable energy sources like hydroelectric, solar and wind energy produce far less pollution. Solar energy is commonly used on public parking meters, street lights and the roof of buildings. Wind power has expanded quickly, its share of worldwide electricity usage at the end of 2014 was 3.1%. Most of California's fossil fuel infrastructures are sited in or near low-income communities, and have traditionally suffered the most from California's fossil fuel energy system. These communities are historically left out during the decision-making process, and often end up with dirty power plants and other dirty energy projects that poison the air and harm the area. These toxicants are major contributors to health problems in the communities. As renewable energy becomes more common, fossil fuel infrastructures are replaced by renewables, providing better social equity to these communities. Overall, and in the long run, sustainable development in the field of energy is also deemed to contribute to economic sustainability and national security of communities, thus being increasingly encouraged through investment policies.

One of the core concepts in sustainable development is that technology can be used to assist people meet their developmental needs. Technology to meet these sustainable development needs is often referred to as appropriate technology, which is an ideological movement (and its manifestations) originally articulated as intermediate technology by the economist E. F. Schumacher in his influential work, Small is Beautiful. and now covers a wide range of technologies. Both Schumacher and many modern-day proponents of appropriate technology also emphasise the technology as people-centered.

Transportation is a large contributor to greenhouse gas emissions. It is said that one-third of all gasses produced are due to transportation. Motorized transport also releases exhaust fumes that contain particulate matter which is hazardous to human health and a contributor to climate change.Some Western countries are making transportation more sustainable in both long-term and short-term implementations. An example is the modification in available transportation in Freiburg, Germany. The city has implemented extensive methods of public transportation, cycling, and walking, along with large areas where cars are not allowed.

It has been argued that since the 1960s, the concept of sustainable development has changed from "conservation management" to "economic development", whereby the original meaning of the concept has been stretched somewhat.

In the 1960s, the international community realised that many African countries needed national plans to safeguard wildlife habitats, and that rural areas had to confront the limits imposed by soil, climate and water availability. This was a strategy of conservation management. In the 1970s, however, the focus shifted to the broader issues of the provisioning of basic human needs, community participation as well as appropriate technology use throughout the developing countries (and not just in Africa). This was a strategy of economic development, and the strategy was carried even further by the Brundtland Commission's report on Our Common Future when the issues went from regional to international in scope and application. In effect, the conservationists were crowded out and superseded by the developers.

But shifting the focus of sustainable development from conservation to development has had the imperceptible effect of stretching the original forest management term of sustainable yield from the use of renewable resources only (like forestry), to now also accounting for the use of non-renewable resources (like minerals). This stretching of the term has been questioned. Thus, environmental economist Kerry Turner has argued that literally, there can be no

such thing as overall "sustainable development" in an industrialised world economy that remains heavily dependent on the extraction of earth's finite stock of exhaustible mineral resources: "It makes no sense to talk about the sustainable use of a non-renewable resource (even with substantial recycling effort and use rates). Any positive rate of exploitation will eventually lead to exhaustion of the finite stock."

Sustainable Development: Definition and Principles. Although many definitions abound, the most often used definition of sustainable development is that proposed by the *Brundtland Commission* (Cerin, 2006; Dernbach J. C., 1998; Dernbach J. C., 2003; Stoddart, 2011). This broad definition, which will be used in this dissertation, does not limit the scope of sustainability. The explanation does, however, touch on the importance of intergenerational equity. This concept of conserving resources for future generations is one of the major features that distinguish sustainable development policy from traditional environmental policy, which also seeks to internalize the externalities of environmental degradation. The overall goal of sustainable development is the long-term stability of the economy and environment; this is only achievable through the integration and acknowledgement of economic, environmental, and social concerns throughout the decision making process. In the application of this definition of sustainable development, one issue concerns the substitutability of capital. There are several types of capital: social, natural, and man-made. The definition of weak sustainable development explains that only the aggregate level of capital matters: man-made, or manufactured, capital is an adequate alternative to natural capital. Strong sustainability, on the other hand, recognizes the unique features of natural resources that cannot be replaced by manufactured capital.

Most ecologists and environmentalists are proponents of the strong sustainability definition. In addition to substitutability, this definition of sustainability is also founded on several other important principles. Contained within the common definition of sustainable development, intergenerational equity recognizes the long-term scale of sustainability in order to address the needs of future generations (Dernbach J. C., 1998; Stoddart, 2011). Also, the polluter pays principle states that "governments should require polluting entities to bear the costs of their pollution rather than impose those costs on others or on the environment" (Dernbach J. C., 1998, p. 58). Thus, government policy should ensure that environmental costs are internalized wherever possible; this also serves to minimize externalities. The precautionary principle establishes that "where there are threats of serious or irreversible damage; lack of full

scientific certainty shall not be used as a reason for postponing costeffective measure to prevent environmental degradation" (United Nations Conference on the Human Environment, 1992). Therefore, the proponent of an activity bears the burden of proving that this action will not cause significant harm. Explicitly stated in the Rio Declaration, the notion of common but differentiated responsibilities recognizes that each nation must play their part on the issue of sustainable development.

This principle also acknowledges the different contributions to environmental degradation by developed and developing 3 nations, while appreciating the future development needs of these less developed countries (Brodhag&Taliere, 2006; Dernbach J. C., 1998; United Nations Conference on the Human Environment, 1992). Developed nations, therefore, bear greater responsibility in light of the resources they require and the pressures they exert on the environment. The key principle of sustainable development underlying all others is the integration of environmental, social, and economic concerns into all aspects of decision making. All other principles in the SD framework have integrated decision making at their core (Dernbach J. C., 2003; Stoddart, 2011). It is this deeply fixed concept of integration that distinguishes sustainability from other forms of policy. Institutionally, government organizations are typically organized into sectoral ministries and departments. This works fairly well until the system encounters something very comprehensive and highly integrated in nature, such as sustainable development. In practice, sustainable development requires the integration of economic, environmental, and social objectives across sectors, territories, and generations. Therefore, sustainable development requires the elimination of fragmentation; that is, environmental, social, and economic concerns must be integrated throughout decision making processes in order to move towards development that is truly sustainable.

The Concept of Sustainable Development of the Republic of Kazakhstan to the Period 2007-2024, Presidential Decree No 216 of 2006. The Concept for Sustainable Development (Concept) is a comprehensive guide to planning national development over a period of nearly two decades. The Concept was developed within the framework of the World Summit on Sustainable Development (Johannesburg, 2002) by the Ministry of Environment with support from UNDP, UNEP-EU, as well as scientists and experts.

This policy calls for the increase of the environmental sustainable index up to 10% by 2012, 15% by 2018, and 25% by 2024.

The Concept lays out the four stages of development:

• Preparation stage (2007-2009) is to establish the institutional readiness to integrate sustainable development principles into all aspects of political and economics spheres

• In the first stage (2010-2012) the country aims to become one of the fifty most competitive countries in the world economy

• During the second stage (2013-2018) the focus is on quality of life for citizens, decrease in environmental degradation, and increase of environmental sustainability

• The third stage (2019-2024) Kazakhstan will achieve international standards of sustainable development

The general goal of the Concept is "to achieve an economic, social, environmental, and political balance of the development of the Republic of Kazakhstan as a base for improvement of quality of life and provision for the competitiveness of the country in the long-term period."

The decree lays out eight principles for Kazakhstan's sustainable development broadly related to improving the economic and social development indicators of the country. The principles are followed by 16 priorities, a number of which are related directly or indirectly to climate change mitigation or adaption. Those priorities are:

- Introduction of sustainable models of production and consumption
- Introduction of innovative environmentally safe technologies
- Development of sustainable transportation systems
- Energy efficiency and energy saving
- Development of science and education for sustainable development
- Prevention and alleviation of environmental threats to the human health
- Decrease of emissions, including GHG and ODS
- Access to quality drinking water
- Solutions to trans-boundary environmental problems
- Waste management

The section on environmental sustainability highlights the need to follow a development path that decreases the anthropogenic impact on climate change. The plan stipulates that the country should use national and local budgets in addition to international loans and grants to achieve its sustainable development

goals; the adoption and enforcement of "polluter pays" policies meant to penalise those entities that contaminate the environment (including excessive CO^2emissions), the introduction of trading emissions quota system (the ETS, now in its first year of operation).

Test tasks for self-control:

1 In what year was adopted by the Republic of Kazakhstan Concept of Transition to Sustainable Development:

a) 1992

b) 1996

c) 1998

g) There is no right answer

2. What type of economy is characteristic for the weak of sustainable development:

a) environmentally balanced

b) Stable

c) environmental capacity

g) There is no right answer

3. To what type of programs include the Basel Convention on transboundary movements of waste:

a) Regional

b) International

c) Global

g) There is no right answer

4. Which group programs include radiation rehabilitation of the Ural region:

a) Local

b) Global

c) Regional

g) There is no right answer

5. What type of development corresponds to the modern world economy:

a) environmentally balanced

b) Man-made

c) Steady

g) There is no right answer

6. In what year was adopted by the World Program of sustainable development:

a) 1992

b) 1995

c) 1998

d) there is no correct answer

7. What type of economy is characterized by the development of the Russian Federation:

a) environmentally balanced

b) Stable

c) environmental capacity

g) There is no right answer

8. What are the ecological funds are functioning on the territory of the Russian Federation:

a) Baikal Foundation

b) the Aral Sea Fund

c) Protection Fund of Yamal

d) All of the above

9. when the last International Conference on Sustainable Development:

a) 1992

b) 1995

c) 2002

g) There is no right answer

10. Which international financial in the field of environmental protection institutions are in the world:

a) The International Bank for Reconstruction and Development (IBRD)

b) The European Bank for Reconstruction and Development (EBRD)

c) The World Bank (WB)

d) All of the above

THEME 10. ENVIRONMENTAL PRINCIPLES OF SUSTAINABLE DEVELOPMENT

10.1. Characterization and classification of natural resources
10.2. Rational nature management
10.3. Development of low-waste technologies
10.4. Protected areas as a form of environmental protection

The natural (surrounding, geographical) environment is the habitat and activity of living organisms. It consists of the lithosphere, hydrosphere, atmosphere and near-Earth space. Allocate natural conditions and resources (natural factors).

Natural resources are the bodies and forces of nature that are used by man to maintain his existence. These include sunlight, water, air, soil, plants, animals, minerals and everything else that is not created by man, but without which it can not exist any living thing. They are used as direct consumption items (drinking water, air oxygen, wild edible and medicinal plants, fish, etc.), the means of labor through which social production is carried out (land, waterways, etc.), energy sources (hydropower, reserves of fossil fuels, wind energy, etc.).

In addition, natural resources are used for recreation, recreation and other purposes.

Natural conditions are elements of nature that affect the life and activity of a person, but are not involved in material production. As the economic activity develops, the conditions become resources.

Natural resources have a different quality for a person:

1. As direct items of consumption (water, oxygen, etc.).
2. As means of labor and social production (land, soil resources).
3. As objects of labor and the source of material (wood, minerals).
4. As sources of energy (oil, gas, coal).

It is vitally important to determine the reserves of certain natural resources, which involves certain uncertainties:

1. The exploration and discovery of new deposits is ongoing.
2. The technology of extraction and processing is being improved, thereby slowing the growth rates of their consumption in comparison with the growth rates of production.

3. Previously unused reserves of natural resources and conditions are involved in production.

Natural resources are classified (Figure 46) in accordance with the following characteristics:

1. On their use - on production (agricultural and industrial), health (recreational), aesthetic, scientific, etc.;

2. By belonging to one or another component of nature - land, water, mineral, animal and plant world, etc.;

3. By substitutability - for substitutable (for example, fuel and mineral energy resources can be replaced by wind, solar energy) and irreplaceable (oxygen for breathing or fresh water for drinking can not be replaced); (figure 38)

4. By exhaustibility - on exhaustible and inexhaustible. Division by use is highly conditional, since the same resource, for example water in the lake, can be used for industrial, agricultural, and recreational purposes or have great aesthetic value.

To inexhaustible resources, you can conditionally include sunlight, atmospheric air, water, wind energy, falling water, etc. However, it is important not only the quantity, but also the quality of these resources: for example, not water in general, but water suitable for drinking; not air at all, but air, suitable for breathing, etc. Thus, a part of even quantitatively inexhaustible resources can become unsuitable for use due to a change in its quality under the influence of human activity.

Exhausted natural resources are divided into renewable, relatively renewable and non-renewable.

Non-renewable resources are resources that are not completely restored or restored many times slower than used by humans. These include minerals located in the bowels of the earth. The use of these resources leads to their exhaustion.

Relatively renewable natural resources include soil and natural resources that have the capacity for self-healing, but this process has been going on for decades and even centuries.

Renewable resources are resources that are capable of regeneration through reproduction or other natural cycles (for example, precipitation) for terms commensurate with the timing of their consumption. These include vegetation, fauna and some mineral resources, deposited on the bottom of lakes and sea lagoons.

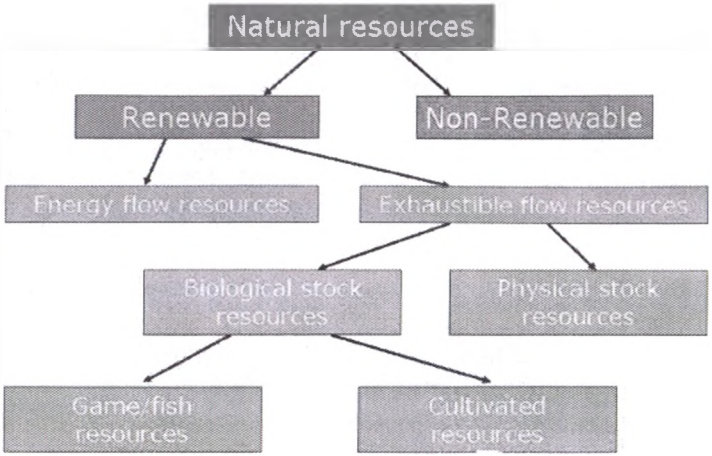


***Figure 38**- The scheme of classification of natural resources*

Under the rational nature management is understood the study of natural resources, their careful exploitation, protection and reproduction, taking into account not only the present, but also the future interests of the development of the national economy and the preservation of human health. Unfortunately, the current state of nature management in most cases can be characterized as irrational, leading to the depletion (until the disappearance) of natural resources, even recoverable ones; pollution of the environment.

Principles of organization of safe production processes

Currently, the main task is the development of technologies that will make the anthropogenic cycle more closed, the so-called low-waste and non-waste technologies. Low-waste technology is a method of production that provides the most efficient use of raw materials and energy with a minimum of waste.

A set of measures to minimize the amount of hazardous waste and reduce their impact on the environment include:

- Development of systems for processing waste products into secondary material resources;
- Development of drainless process systems and water cycle cycles based on wastewater treatment;
- The creation and release of new types of products, taking into account the requirements for its re-use;

• Creation of fundamentally new production processes that allow to exclude or reduce the technological stages at which waste is generated.

The great prospects in the field of environmental protection are the achievements of biotechnology. Biotechnology is the production of products and materials necessary for human beings with the help of living organisms, cultured cells and biological processes. The achievements of science allow us to create drugs for the regulation of the circulation of substances in ecosystems, which allows us to solve applied problems:

• Bio-purification of natural and waste water from pollutants;

• Processing of solid phase of sewage and household waste by fermentation;

• Microbial soil restoration, primarily contaminated with organic substances;

• Use of microorganisms to neutralize heavy metals in sewage sludge and contaminated soils;

• Composting or biological oxidation of waste vegetation - leaves, straw and other.

• Creation of biologically active sorbing material for the purification of polluted air.

• Protected areas as a form of environmental protection

• To preserve the biological diversity of the state, it is necessary to further develop the specially protected natural areas of the Republic of Kazakhstan (hereinafter - SPA).

In accordance with the Law of the Republic of Kazakhstan "On Specially Protected Natural Territories", specially protected natural areas are lands, waters, forests and subsoil with a special regime for special protection or a regulated mode of economic activity that ensure the preservation and restoration of the state natural reserve fund.

Depending on the purposes, protection regimes and features of use in the RK, the following types of specially protected natural areas are distinguished:

- national nature reserves, including biosphere reserves;
- national national nature parks;
- national natural parks;
- national natural monuments;
- national protected areas;
- national nature reserves;
- national zoological parks;
- national botanical gardens;

- national dendrology parks;
- forests of specially protected natural areas;
- water bodies of special national importance or special scientific value;
- wetlands of international importance;
- subsoil plots representing a special ecological, scientific, cultural and other value.

The State Nature Reserve is a specially protected natural area with the status of an environmental institution and a protected regime of protection designed to preserve in the natural state of typical, rare and unique natural complexes with the totality of their components. State nature reserves have the highest category of specially protected territories of territories of national importance.

The State National Natural Park is a specially protected natural area with the status of an environmental institution and zone-based protection regimes designed for the diversified use of natural and historical and cultural complexes and facilities that have a special ecological, recreational, scientific and other value. State national nature parks have a category of republican significance.

The state natural park is an analogue of the state national natural park, which set the same tasks and performs the same functions, but belongs to the category of a specially protected natural area of local significance with the status of an environmental institution.

The State Nature Monument is a specially protected natural area with a protected regime, designed to preserve in the natural state of individual objects of the state natural reserve fund.

The state natural reserve is a specially protected natural area with a custom regime or a regulated mode of economic activity designed to preserve and reproduce one or several objects of the state natural reserve fund. State nature reserves can be zoological, botanical, hydrological, geological, geomorphological, hydrogeological, soil , landscape and complex. State natural reserves can be of local and national importance.

Currently in the Republic of Kazakhstan officially registered:

- 7 national natural parks (Altyn-Emel, Bayanaulsky, Ile-Alatau, Karakaraly, Katon-Karagai, Kokshetau, Charynsky);
- 10 national nature reserves (Aksu-Zhabaglinsky, Alakolsky, Almatinskiy, Barsakelmesky, Western Altai, Karatau, Korgalzhinsky, Markakolsky, Naurzum, Ustyurt);
- 2 national natural reserves ("SemeyOrmany", "ErtisOrmany");
- 2 national natural parks ("Buiratau", "Medeo").

Ecological monitoring.Environmental assessment. Preservation of biological and landscape diversity.

Environmental monitoring describes the processes and activities that need to take place to characterise and monitor the quality of the environment. Environmental monitoring is used in the preparation of environmental impact assessments, as well as in many circumstances in which human activities carry a risk of harmful effects on the natural environment. All monitoring strategies and programmes have reasons and just ifications which are often designed to establish the current status of an environment or to establish trends in environmental parameters. In all cases the results of monitoring will be reviewed, analysed statistically and published. The design of a monitoring programme must therefore have regard to the final use of the data before monitoring starts. Complex environmental monitoring of the environment is the organization of a system for monitoring the state of environmental objects to assess their actual level of pollution and warning of critical situations that are harmful to human health and other living organisms.

In carrying out comprehensive environmental monitoring of the environment:

a) a continuous assessment of the environmental conditions of the human habitat and biological objects (plants, animals, microorganisms, etc.), as well as an assessment of the state and functional integrity of ecosystems;

b) conditions are created for determining corrective actions in cases when the targets of environmental conditions are not reached.

The system of integrated environmental monitoring provides for:

- selection of the object of observation;
- survey of the selected object of observation;
- compiling an information model for the object of observation;
- planning of measurements;
- assessment of the state of the object of observation and identification of its information model;
- prediction of the change in the state of the object of observation;
- presentation of information in a user-friendly form and bringing it to the consumer.

Environmental monitoring emerged at the junction of ecology, biology, geography, geophysics, geology and other sciences. There are different types of monitoring depending on the criteria: bioecological (sanitary-hygienic), geoecological (natural-economic), biospheric (global), space, geophysical, climatic, biological, public health, social, etc.

Depending on the severity of the anthropogenic impact, the monitoring of impact and background is distinguished. Background (base) monitoring - tracking of natural phenomena and processes occurring in a natural environment, without anthropogenic influence. It is carried out on the basis of biosphere reserves. Impact monitoring - monitoring of anthropogenic impacts in especially hazardous areas.

Depending on the scale of surveillance, global, regional and local monitoring are distinguished.

Points of environmental monitoring are located in large settlements, industrial and agricultural areas (cities, highways, territories of industrial and energy centers, nuclear power plants, oil fields, agroecosystems with intensive use of pesticides and fertilizers, etc.).

At the level of local (sanitary-hygienic, bio-ecological, impact) monitoring, the most important is monitoring the following indicators:

The concentration of pollutants, the most dangerous for natural ecosystems and humans, in life-sustaining environments:

- in atmospheric air: oxides of carbon, nitrogen, sulfur dioxide, ozone, dust, aerosols, heavy metals, radionuclides, pesticides, benz (a) pyrene, nitrogen, phosphorus, hydrocarbons;
- in surface waters: radionuclides, heavy metals, pesticides, benz (a) pyrene, pH, mineralization, nitrogen, oil products, phenols, phosphorus;
- in the soil: heavy metals, pesticides, radionuclides, petroleum products, benz (a) pyrene, nitrogen, phosphorus;
- in biota: heavy metals, radionuclides, pesticides, benz (a) pyrene, nitrogen, phosphorus.

At the level of regional (geosystemic, natural-economic) monitoring, observations are made of the state of ecosystems of large natural-territorial complexes (river basins, forest ecosystems, agroecosystems, etc.), differences in their parameters from background territories are recorded, due to anthropogenic impacts.

At the level of global (biospheric, background) monitoring, changes in the biosphere as a whole are monitored. The objects of global monitoring are the atmosphere, hydrosphere, soil cover, flora and fauna and the biosphere as a whole as the environment of the life of all mankind.

A special role in the system of ecological monitoring is played by biological monitoring, that is monitoring of the biotic component of ecosystems (biota). Biological monitoring is the control of the state of the environment with the help of living organisms. The main method of biological monitoring is

bioindication, which consists in recording any changes in biota caused by anthropogenic factors. Bioindication is the detection and determination of biologically and ecologically significant anthropogenic loads on the basis of the reaction of living organisms and their communities to them. Living organisms, by the presence, condition and behavior of which can be judged by a change in the environment, are called bioindicators.

Conducting environmental monitoring allows you to quantify all those negative processes in nature that cause human activity. It also allows to see and positive results of nature protection measures.

Ecological examination - establishment of compliance of the planned economic and other activities with environmental quality standards and environmental requirements, as well as determining the feasibility of the implementation of the environmental expertise in order to prevent possible adverse effects of this activity on the environment and associated social consequences.

In the Republic of Kazakhstan, state ecological expertise and public environmental expertise are carried out.

Ecological examination is conducted in order to:

1) determination and limitation of possible negative consequences of the planned management, economic, investment, normative and other activities on the environment and public health;

2) compliance with the balance of interests of economic development and environmental protection, as well as preventing damage to third parties in the process of nature management.

State environmental assessment is carried out by the authorized body in the field of environmental protection and by local executive bodies within their competence.

The state ecological expertise is mandatory and must precede the adoption of legal, organizational and economic decisions regarding the use of natural resources and the impact on the environment and public health. Without a positive conclusion of the state environmental review, the project is prohibited.

In recent decades, the problem of conservation of biological diversity has been formulated; conservation of the entire set of biological species existing on the earth and their habitats. One of the sources of this problem is the concept of biocentrism, which considers all biological species, including humans, equally valuable. In reality, life is infinite in the variety of forms of its existence. But only some of them are compatible with the existence of man.

Nevertheless, biological diversity is valuable as a basis:

1) the further evolution of living nature;

2) adaptability of biota to possible changes in the external environment;

3) the preservation of biological relationships and dependencies that ensure the sustainability of ecosystems (and not known in full by scientists).

When using the concept of biological diversity, it is necessary to understand that biological diversity is not equivalent to ecological well-being. First, in a number of cases, the formed stable ecosystems are monodominant and their destruction (for example, deforestation) leads to a change in biocenosis and an increase in biological diversity. The increase in biodiversity can also be caused by pollution of the natural environment, which is also associated with increased opportunities for interspecific competition.

Despite all measures taken, the absolute amount of renewable natural resources - forests, arable land, suitable for drinking purposes of water bodies decreases from year to year. This indicates that they are not effective enough, and the declared tasks are most often pursued by political goals.

Test tasks for self-control:

Question number 1

Biosphere represents

complex species in a certain area

shell of the Earth, inhabited by living organisms

hydrosphere, populated by living organisms

a set of ground biogeocenosis

Question number 2

The primary source of energy for the circulation of substances in most biogeocenosis -

sunlight

activities of producers in the ecosystem

microbial activity

dead organic residues

Question number 3

Living matter of the biosphere - is the set of all

plant and animal planet

multicellular organisms of the planet

planet microorganisms

living organisms of the planet

Question number 4

Chemosynthetic bacteria in the ecosystem

ready to consume organics

decompose organic substances to mineral

decomposed minerals

create organic substances from inorganic

Question number 5

Introduction of legumes in crop rotations contributes agrotcenozov

reduction of acreage

reduction of soil erosion

accumulation of nitrogen in the soil

phosphorus compounds soil enrichment

THEME 11. ECONOMIC ASPECTS OF SUSTAINABLE DEVELOPMENT. GREEN ECONOMY AND SUSTAINABLE DEVELOPMENT. WATER RESOURCES MANAGEMENT

11.1. Ecological conditionality of the economy. The natural environment as a basis for economic development

11.2. Measuring the production and natural potentials. Ecological and economic system, conditions for its sustainable development

11.3. Management of natural resources

11.4. Green Economy and Sustainable Development

Ecological conditionality of the economy

The current ecological and economic situation points to the need to replace the established techno centric image of the economy with a sustainable, ecologically balanced type of economic development. We need a review of priorities in both macro and microeconomics. At the same time, all macroeconomics should be included in macro ecology. Their independence becomes more and more imaginary. This fact will have to get used not only to economists, but also to ecologists.

The basis of macroeconomics is formed by two fundamental facts:

The material needs of people and of the entire human society are endless and unquenchable;

Material resources - means of meeting needs - are limited or rare. These facts cover the whole problem of economy, which reflects the economic criterion of optimality - the maximum possible satisfaction of needs with limited resources. But it is this basis of macroeconomics that has become the central problem of ecology, since the development of civilization and especially of modern economy has caused a large volume of supra-biological consumption. And most of the resources of the technosphere - non-biotic resources - both before and after their processing by man are not suitable for natural assimilation in the ecosphere. These factors, multiplied by a large number of people, which are partly also caused by the economy, have become the main causes of the disturbance of natural balance and deterioration of the quality of the environment.

Dependence of the economy on the resources of the biosphere. The level of people's well-being is determined by all factors of social life, but above all - by primary, environmentally significant factors of life support - food, water,

clothing, housing. They form the most constant, basic part of the structure of needs. Percapita, this proportion of consumption is relatively little related to economic growth.

Historically, the entire economic growth attributed to one person is almost entirely due to an increase in the use of extra-biological resources, sources of secondary means of consumption. This is due to the expansion of the exploitation of subsoil resources. The technosphere has grown on this basis. Hence the impression of an increase in the independence of the economy from the resources of the ecosphere. Indeed, the aggregate of industries that provide primary needs - agriculture, partly food, light industry and utilities - in most developed countries form not the largest sector of the economy, but in the world as a whole - 32% of the total contribution to GDP. However, you can look at it in a different way.

The most important human needs - food, oxygen, clothes, in a certain part of the water and housing - like thousands of years ago, are mostly satisfied with products of living nature. The fact that many of these products are now obtained not from pristine forests and steppes, but in fields and farms, reflects not so much a decrease in dependence on natural biological processes, but rather a redistribution of human labor. Oil, gas and coal are also the products of living organisms that existed in the geological past of the Earth. From the shells of sea creatures, there are layers of limestone and dolomite, which give the building material and raw materials for the production of cement and concrete. Thanks to the activity of microorganisms, deposits of saltpeter and phosphorites were formed from the remains of sea inhabitants and excrement of birds: microbes participate in the formation of ores of certain metals. Living organisms underlie fertile soils branches of the economy are highly dependent on natural resources that are formed in the course of ecological processes (Table 9).

Table 9

Dependence of the branches of the world economy on the raw material supply of production volume from modern (A) and ecological processes and resources of the biosphere, related to the geological past of the Earth (B), (in%)

Industries	A	Б
Energetics	9	78
Oil refining and coal-gas-chemistry	-	100
Buildingmaterialsindustry	10	55
Wood processing and paper industry	100	-

Agriculture	80	10
Livestockraising	100	-
Fishery	100	-
Foodandmicrobiologicalindustry	100	-
Lightindustry	70	30

The provision of the economy with natural resources for a long time was not perceived as a dependence on the laws of ecology. But with the growth of production and especially in the twentieth century, this dependence began to manifest itself more often and more often. It turned out that in order to compensate for a one-percent decline in soil fertility, the costs of maintaining the previous yield should be increased by 10%. It turned out that the best secondary, i.e. Grownon the site of deforestation can not be compared with the virgin forest either for products or for the quality of wood. After several species of commercial fish disappeared due to predation in the Atlantic, it became clear that to preserve the sustainable production of fish products it is necessary to take into account the ecology of fish populations. Governments and fishing companies in a number of countries in Europe and America have allocated large sums for the development of such studies. The change of generations and resistance to poisons in the Colorado potato beetle not only affects the prices of potatoes, but also affects the financing of chemical research and the production of a whole range of pesticides. A fifth of the total losses of metal destroyed by corrosion, and 77% of losses from corrosion of oil equipment are associated with biocorrosion - the activity of microbes. Algae, mollusks and other organisms - "fouling", settling on the bottoms of ships, can significantly reduce the speed of movement and lead to a noticeable over-consumption of fuel. Annual losses of wood from fungal diseases and mass reproduction of insects in Russia alone amount to more than 20 million m^3. Even such a situation as Japan's desire to regain the South Kurils is due not so much to political ambitions as to the attractiveness of the water area of this zone where the usual ways of migrating Pacific salmon are, the richest crab banks and congregations of herds of saury are located.

There are many more examples of how ecology affects the economy. However, it should be reiterated that the most significant influence is due to those changes in nature that are caused by human economic activity. The total economic damage inflicted in the second half of the 20th century on natural systems, the environment, and through them to human health, now far exceeds the global annual budget. Nevertheless, the practical economy spontaneously

resists increasing the influence of environmental factors and environmental debt on it, as they impose restrictions on the growth of the economy and increasingly demand a huge loan repayment.

Measuring the industrial and natural potentials

The idea of reconciling economic and natural potentials is not limited only to the subordination of the ecological imperative - the requirement of natural systems and their advocates to reduce industrial expansion. Balancing is needed not only by natural complexes and the environment of people, but also by industrial production itself. It has not only environmental and hygienic significance, but also a direct economic one: the equilibrium conjugation of production and environmental processes not only forces us to limit the input capacities of production, but also offers an additional economic tool for controlling the effectiveness. Economic growth exceeding the threshold of permissible loads acts as the main destabilizing factor for the environment. That is why the commensurability and harmonization of economic and natural potentials and the formation of an eco-economic system should be the subject of economic theory and practice. The implementation of the principle of balance and the development of norms and means for the environmental regulation of economic activities require a real comparison of the technogenic burden with the stability of the entire natural complex of the territory, the stability of the quality of the environment and the state of recipients. It is believed that the requirement of co-measurement implies a restriction of industrial development. Unfortunately, many business leaders, production managers and entrepreneurs alike perceive the tasks of environmental protection and balanced nature management. But in reality it is a question of another - the limitation of the nature - the capacity of production. Under the nature of production should be understood all the damage that is caused to natural objects and resources, the state of the environment and human health by the construction and operation of economic facilities, their waste and production.

At each enterprise, in addition to the outlays of labor, raw materials, materials, energy, a certain amount of clean water, clean air, living soil, living organisms, other natural objects is expended in order to obtain products, and finally, some part of the health of people, as directly participating in production, and located in the zone of negative influences of the economic object, its waste and products. Just as in the economy of production the concepts of labor intensity, material intensity, energy intensity of production or production are used, one can speak about the nature of production. And of all these

"capacitive" indicators, nature conservation is the most important. Nevertheless, the greening of production requires the development and mastery of such calculations. In addition, as will be shown below, environmental intensity is closely related to the energy intensity of production.

Ecologization of the economy imposes restrictions on all elements of extensive development, which can lead to increased extraction of natural resources and increased pollution of the environment. A transition to a qualitative growth strategy is needed, when changing the stereotype of needs, efficient resource saving and a qualitative reorganization of the economic and production cycle will ensure the satisfaction of people's needs without increasing the amount of energy and mass of substances and materials involved in production (Chapter 8).

Measurement of the nature of production can be carried out by the method of direct calculation of economic damage caused by construction, operation of the enterprise, its land use, water intakes, emissions and sinks, the effects of environmental pollution.

Until recently, such calculations were applied only in connection with air and water pollution and did not have a significant impact on the production economy, although full consideration of environmental resources with appropriate legal support should significantly change the economic criteria for profitability, payback and productivity.

Simplified indirect assessment of environmental intensity, more precisely its most significant part, due to environmental pollution, can be made using an energy criterion. Energetic approach to the analysis of ecological-economic relations in general is of great importance. It has its own history, is well founded and deserves special consideration. Its productivity is partly demonstrated in describing the energy flow in the biosphere (Chapter 2). The energy approach was applied by the authors to measure the natural and productive potentials of the territory in relation to the ecological and economic analysis of industrial sites. Here we confine ourselves to just pointing out that according to numerous data using the law of large numbers, there is an almost linear functional relationship between energy consumption and the nature of production. For each technology or for a set of related or related technologies in one industry, a fairly constant relationship between the production of harmful products and energy consumption can be indicated. These so-called contamination equivalents of energy make it possible to calculate, on the basis of energy consumption data, the mathematical expectation of environmental

contamination, which is usually in good agreement with direct quantitative estimates.

In the case of large industrial complexes, the reliability of this method is enhanced by the fact that both the prevailing share of energy (fuel) consumption and the largest mass of harmful emissions fall on thermal stations and transport, for which the "fuel-pollution" relationship is easily determined. The energy approach allows us to significantly refine the information on the extent of environmental pollution.

Ecological and economic system, conditions for its sustainable development

The concept of the ecological and economic system (EES) is widely used in the modern economic and environmental literature, along with coinciding or very similar concepts "natural-economic system" and "bioeconomic system". There are two levels of interpretation of this concept - global and territorial.

According to the first power plant, it is treated as a special new economic structure of society as a whole, the type of ecologically regulated socio-economic formation, that is, what is the object and purpose of sustainable development. It was in this sense at the closing of the Rio Conference that Maurice Strong spoke of the need for the transition of mankind from the economic system to the ecological and economic system. Academician M. Ya. Lemeshev as early as 1976 defined the ecological and economic system as "the integration of economy and nature, which is an interrelated and interdependent functioning of social production and the flow of natural processes in nature and in the biosphere in particular." Such a view implies at least a national level of the formation or organization of EPS. However, neither in the world as a whole, nor in a single country, such "integration of the economy and nature" can not be realized immediately and everywhere. Therefore, bearing in mind the approaches to practical implementation of the principle of balanced nature management, it is important to have an idea of the EES at the territorial level - in certain regions, territorial production complexes, industrial agglomerations, etc.

In this interpretation, the ecological and economic system is a part of the technobiosphere, limited by a certain territory, in which natural, social and production structures and processes are linked by mutually supporting flows of matter, energy and information. The latter does not mean that nature in principle could not do without "supportive" influences on the part of human society, but only emphasizes the fact that in modern conditions the technogenic pressure on nature should be regulated precisely on the basis of mutual support.

The concept of the technobiosphere in this case reflects the fact that the part of the terrestrial biosphere is substantially transformed by direct and indirect effects of human technical means in accordance with its social and economic needs.

The ecological and economic system is a certain combination of jointly functioning ecological and economic systems, possessing new, emergent properties that are not reducible to the sum of the properties of the constituent parts. Recall that the ecological system is a community of living organisms, so interacting with each other and with the environment, that the flow of energy creates clearly defined biotic structures and a cycle of substances between the living and inanimate parts of the system. Such a view not only describes the biosphere component of the human environment, but does not prohibit the inclusion of himself in the "community of living organisms." However, the history of social development forces us to relate man to the socio-economic subsystem, leaving behind him the function of the most important link in the relationship between social production and nature. In turn, the production economic system is an organized set of productive forces that transforms the input material and energy flows of natural and productive resources into output streams of consumer goods. Thus, a part of the material elements of the ecological system, including elements of the human environment, is used as a resource of the economic system.

In the production process, only a part of these resources are converted into consumer goods and, in addition, there is a more or less rapid irreversible replacement of consumer goods, a significant amount of production and consumption waste is generated, and there is a constant reverse material flow from the economic system to the ecological one. Natural resources are the most important components of the human environment, used to meet the material and cultural needs of society.

They are very diverse, as well as the possibilities of their use by man. The limited resources of the Earth are now one of the most pressing problems of human civilization. Therefore, one of the most important moments of our time can be considered the solution of problems in the rational management of natural resources.

This requires not only extensive and in-depth knowledge of the laws and mechanisms of the functioning of ecological systems, but also a certain moral education of society, people's awareness of their unity with nature, the need to restructure the system of social production and consumption. Nature use takes various forms depending on the types of natural resources: consumable (energy,

raw materials, food, gene pool) and environmental resources (working, rest and health conditions). Approaches to managing commercial populations.

Any exploited population is characterized by a certain productivity, produced in a unit of time by a new biomass. With such exploitation, a person withdraws a part of the biomass in the form of a crop representing one or another part of the bioproducts. The presence of intraspecific or interspecific competition, the impact of unfavorable environmental conditions and other factors can reduce the product (natural increase). And the difference between it and the crop can noticeably decrease or even become negative. In the latter case, the seizure will exceed the natural increase in the biomass of the population. A reasonable approach to the use of biological resources consists of:

• In maintaining the productivity of the population at the highest possible level;

• harvesting, the value of which is as close as possible to the product produced by the population.

Such regulation presupposes a profound knowledge of the ecology of the exploited population, the development and observance of norms and rules for its use. There are only three ways in which the productivity of the population can be managed.This - birth rate, mortality, growth rate of individuals. All these characteristics are influenced by many factors: food resources, climate and soil conditions, the presence of moisture, light, heat, the degree of population density, interaction with other species, the presence of parasites, diseases and other. Supporting favorable conditions and suppressing negative influences, a person can regulate the production (growth) of biomass, achieving the maximum speed of this process. By changing the intensity of biomass extraction (the size of the harvested crop), a person can have both a positive and negative impact on the population in the biogeocenosis.

Speech in this case is about the formation of such a strategy for the development of human society, which allows to harmoniously combining its needs with the possibilities of maintaining the normal functioning of the biosphere. This means not only the widespread use of production methods (technologies) for saving energy and resources, but also changing the nature of people's needs, their consumer ideals. At present, we live in a society that is called a society of disposable consumption. It is characterized by irrational, wasteful use of natural resources. To preserve human civilization, it is necessary to build an environmentally friendly society, the basis of which

should be the reasonable use of natural resources. For conscious and qualified management of the economy and nature management it is necessary:

1) Determine the objectives of management;

2) develop a program for their achievement;

3) create mechanisms forth implementation of the tasks.

You already know that solar energy is the energy source of the accumulation of biomass of primary products (green plants) on the Earth. For agriculture, only about 10% of the land surface is suitable, which, under modern conditions, allows a limited crop to be removed. Humanity is already approaching the limit of those opportunities that can be provided by the production properties of the biosphere. Needless to say, natural restrictions affect not only food, but also other natural resources that meet the needs of people in heat, housing, clothing, etc. Thus, rational nature management is the only way out of the situation. The common task of rational management of natural resources is to find the best (according to certain criteria) or optimal methods of exploitation of natural and artificial ecosystems. The main principles of rational nature management are the study, protection, development and transformation of the natural environment. The global recession has brought new attention to chronic structural flaws in current economic models and assumptions. As economies struggle to recover, many are taking a closer look at the broad concept of a "Green Economy," one that simultaneously promotes sustainability and economic growth What would this type of economy look like, and how could we get there? WRI Managing Director Manish Bapna responds to some of the most commonly-asked questions:

Green Economy.A Green Economy can be thought of as an alternative vision for growth and development; one that can generate growth and improvements in people's lives in ways consistent with sustainable development. A Green Economy promotes a triple bottom line: sustaining and advancing economic, environmental and social well-being. The prevailing economic growth model is focused on increasing GDP above all other goals. While this system has improved incomes and reduced poverty for hundreds of millions, it comes with significant and potentially irreversible social, environmental and economic costs. Poverty persists for as many as two and a half billion people, and the natural wealth of the planet is rapidly being drawn down. In a recent global assessment, approximately 60 percent of the world's ecosystem services were found to be degraded or used unsustainably. The gap between the rich and poor is also increasing – between 1990 and 2005, income

inequality (measured by the gap between the highest and lowest income earners) rose in more than two thirds of countries.

The persistence of poverty and degradation of the environment can be traced to a series of market and institutional failures that make the prevailing economic model far less effective than it otherwise would be in advancing sustainable development goals. These market and institutional failures are well known to economists, but little progress has been made to address them. For example, there are not sufficient mechanisms to ensure that polluters pay the full cost of their pollution. There are "missing markets" – meaning that markets do not systematically account for the inherent value of services provided by nature, like water filtration or coastal protection. A "market economy" alone cannot provide public goods, like efficient electricity grids, sanitation or public transportation. And economic policy is often shaped by those who wield power, with strong vested interests, and rarely captures the voice and perspectives of those most at risk.

A Green Economy attempts to remedy these problems through a variety of institutional reforms and regulatory, tax, and expenditure-based economic policies and tools.

The transition to a Green Economy has a long way to go, but several countries are demonstrating leadership by adopting national "green growth" or "low carbon" economic strategies. And there are many examples of successful, large-scale programs that increase growth or productivity and do so in a sustainable manner. For example: *The Republic of Korea has adopted a national strategy and a five-year plan for green growth for the period 2009–2013, allocating 2 per cent of its gross domestic product to investment in several green sectors such as renewable energy, energy efficiency, clean technology and water. The government has also launched the Global Green Growth Institute which aims to help countries (especially developing countries) develop green growth strategies.*

Businesses are increasingly leading progress toward a Green Economy. For example, the carpet company Interface FLOR is improving its competitive positioning in this normally petroleum-intensive industry by focusing on how sustainability can enhance its business model. The company is working towards a closed loop system, meaning that its waste products are also its manufacturing inputs. Its company culture reinforces its goals – when employees know they are making a difference in the world, they tend to work harder and be better at their jobs, making the enterprise more productive. Interface's CEO, Ray

Anderson, has said "If we can do it, anyone can. And if anyone can, everyone can."

First, there is a deeper appreciation today by many governments, companies, civil society and the public that we are reaching planetary limits, not just in terms of greenhouse gas emissions but also in our use of water, land, forests and other natural resources. The environmental and social costs of our current economic model are becoming more and more apparent.

Past sustainability efforts have not focused sufficiently on fixing the failures of economic policies. But we now have a chance to tackle these challenging problems given the policy openings created by the response to the financial crisis.

Second, and perhaps even more important, the global recession has led to a reconsideration of key tenets of the current economic model – such as the primacy of growth and the belief in light-touch regulation. In openly questioning the strength of the status quo, many public- and private-sector leaders are seeking:

- Policies and regulations that can identify and manage financial and other risks more effectively
- New markets and industries that can create good, long-term jobs
- Public support for innovation to position a country to compete in tomorrow's markets

One question people ask is "can we afford this?" We're still in the wake of the global financial crisis and many people perceive Green Economy solutions as expensive. The United States is asking itself whether it can afford to put a price on carbon today. Developing countries are concerned that transitioning to a Green Economy will hinder economic growth and the ability to reduce poverty.

Moreover, there will be short-term, nontrivial losses associated with changes in industry and market structure (e.g., a decline of the coal industry and related job losses.) Supporting those actors who will bear the brunt of the transition will be critical to building broad ownership for a Green Economy.

Some countries feel that they are lagging in green technology know-how and therefore will be at a competitive disadvantage in the race for future markets. Others feel that the Green Economy is a pretense for rich countries to erect "green" trade barriers on developing country exports. These are all legitimate concerns that deserve attention.

Ultimately, a hard-nosed economic analysis should inform decisions on what policies and investments to promote today. When the full costs and

benefits over time are taken into account however, many Green Economy solutions will be seen as more attractive. Nevertheless, there will still be difficult choices and tradeoffs. For example, should India aggressively promote grid-connected, relatively expensive solar power when hundreds of millions in the country still have no access to electricity? And even where Green Economy solutions make economic sense, they may be politically challenging. The transition to a Green Economy will not be easy.

The principal challenge is how we move towards an economic system that will benefit more people over the long run. Transitioning to a Green Economy will require a fundamental shift in thinking about growth and development, production of goods and services, and consumer habits. This transition will not happen solely because of better information on impacts, risks or good economic analysis; ultimately, it is about politics and changing the political economy of how big decisions are made.

The problem is vested interests. Those who benefit from the status quo are either overrepresented in or have greater access to institutions that manage natural resources and protect the environment. U.S. climate legislation, for example, was defeated in no small part by resistance from fossil-fuel based energy advocates.

The following steps would help create a more level policy-making playing field:

Increase public awareness and the case for change. Greater visibility on the need for this transition can motivate voters and consumers - not just because of the costs but also the economic benefits generated by a Green Economy, such as new jobs and new markets. People will not adopt policies because they are green. They will do so when they believe it is in their interest.

Promote new indicators that complement GDP. Planning agencies and finance ministries should adopt a more diverse and representative set of economic indicators that focus less exclusively on growth and track the pace and progress of development.

Open up government decision-making processes to the public and civil society. This would help ensure policies are accountable to the public and not to vested and well-connected interests.

Identify and take advantage of political leadership when available as this will be crucial in order to limit the undue influence of "dirty" economic holdouts.

Timing is everything when it comes to big policy reforms. Green Economy advocates will need to be ready when that window of opportunity presents itself.

Ultimately, the widespread transition to a Green Economy will depend on whether or not the long-term public interest is reflected in today's economic policies.

The main segments in which the green economy can develop are shown in Table 10.

Table 10 - **Economic segments of green economy development**

Segment	Directions
1	2
Energy Generation	Wind, solar, hydro / marine, biofuel, geothermal
Energy storage	Fuel cells, improved batteries, hybrid systems
Energy infrastructure	Management, transmission
Energy Efficiency	Lighting, buildings, glass
Transportation	Vehicles, logistics, structure,fuel
Water and waste water	Water purification, water protection, waste water treatment
Airanden vironment	Purification / safety, emission control, monitoring / compliance, trade and compensation
Materials	Nano Bio Chemical
Production / Industry	Advanced packaging, monitoring and control, intelligent production
Agriculture	Natural pesticides, land management, aquaculture
Recycling and waste	Recycling, wastemanagement

The main directions that contribute to the "greening" of the entire economy can be represented as follows:

1. Forest sector, biodiversity. The forest sector should be more focused not on obtaining wood, but on moderate and sparing exploitation of ecosystem services that support the development of tourism, the water protection and climate-forming role of forests and forest ecosystems. Investments are needed

in the capitalization of natural potential, accounting for the cost of ecosystem services in the budget and regional project policies.

2. "Green" agriculture. Agriculture should gradually be reoriented to less water-intensive crops, lower agrochemical loads, integrated pest and disease control, and erosion technologies. Changes in the political course should primarily be aimed at reducing and, ultimately, stopping the provision of environmentally harmful subsidies that create the wrong idea of the true price of unsustainable agriculture products. "Green" agricultural technologies can significantly increase the yield, especially on small farms.

3. Sustainable management of water resources. The scenario of existing forms of water use does not allow to meet the need for fresh water. Reforms can be aimed at improving institutional arrangements in land use, as well as improving aid delivery systems and allocating funds; to reduce subsidies for investment; as well as to change the payment for water supply and financial schemes. Along with this, there is a need for increased investment in rural water supply systems and rural sanitation.

4. Fisheries sector. To prevent the progressive depletion of fish resources in natural reservoirs, the development of commodity fish farms in compact reservoirs, strict regulation of catch volumes in large reservoirs, stocking, as well as investments in the development of alternative livelihoods are recommended. The present value of the benefits from the "gardening" of the fishing sector is estimated to be about 3-5 times higher than the required investment. An alternative scenario (while preserving the "brown economy") envisages a continuation of the decline and narrowing of the fishing sector due to a shortage and a sharp drop in fish stocks.

5. Renewable energy sources. Thanks to renewable energy technologies and related energy policies, it is expected that a significant contribution will be made to improving living standards and improving the health status of the population in low-income regions, especially remote from electrical networks. Cost-effective solutions include the use of clean biomass and autonomous solar photovoltaic devices, which are characterized by low operating costs and the flexibility of small-scale implementation.

6. Development of tourism. The development of tourism contributes to the growth of the local economy and reduces the level of poverty. Tourists are the driving force behind the "greening" of this sector, as the annual growth of ecotourism shows by 20%, i.e. Six times faster than the tourism industry as a whole. One workplace in the main tourist industry creates about one and a half additional or indirect jobs in economic sectors related to tourism. It is expected

that "greening" this sector will increase the employment potential in the sector due to the growth of local recruitment and increased use of local resources. In the "greening" of the tourism sector, increased involvement of the local community, especially the poor, in the value chain in tourism is an important factor in the development of the local economy and poverty reduction.

7. Waste management and disposal. Employment in waste management and recycling will grow due to the increase in waste generated by population and income growth, although there are significant problems in this sector related to the lack of decent jobs. Sorting and processing of recyclable materials provides 10 times more jobs per ton than waste disposal at landfills or their incineration. In scenarios of "green" investment, the projected growth in the number of jobs in the waste recycling sector is increased by 10% compared to current trends. However, there is something more important than the additional employment potential in the management, recycling and disposal of waste, namely the possibility and even the need to improve jobs in this sector. In order for jobs to be genuinely "green", they must meet the requirements of decent work, including such criteria as a minimum wage, elimination of child labor, labor protection and safety, social security and freedom of association. Improvement of jobs is desirable and necessary for both social and environmental reasons.

Test tasks for self-control:

1.Factory inorganic environment that affect life and distribution of living organisms, called

A) abiotic.

B) alive.

C) Human.

D) biotic.

E) Limiting.

2. Types of adaptation of organisms:

a) Ethological species.

B) Only the physiological types.

C) Only morphological types

D) morphological, ethological, physiological.

E) The legal properties organisms.

3. Who introduced into science the term "ecological system"

A) Vernadsky.

B) Suess.

C) Arthur Tansley.

D) Darwin.

E) Heckel.

4. Interactions between populations in which one of them is suppressed without extracting another benefit to itself

A) mutualism.

B) amensalizm.

C) commensalism.

D) protocooperation.

E) parasitism.

5. Scopeof the mind:

A) Technosphere.

B) The biosphere.

C) Cryosphere.

D) Stratosphere.

E) Noosfera.

6. Substances which facilitate the destruction of the ozone layer:

A) Inorganics.

B) Carcinogens.

C) Freons.

D) Heavy metals.

E) Herbicides.

7. Types of nature:

A) General and individual.

B) The state and the individual.

C) General and special.

D) General and state.

E) State and special.

8. Flora of the Earth are:

A) 700 thousand species of plants..

B) of 400 thousand. Plant species.

C) of 300 thousand. Plant species.

D) of 500 thousand. Plant species.

E) of 100 thousand. Plant species.

9. The conversion of organic compounds from the inorganic light energy due to:

A) Photosynthesis.

B) Photoperiodism.

C) Homeostasis.
D) Climax.
E) Succession.
10. Science studies the character and behavior of the animal
A) Toxicology.
B) Ethology.
C) Ecology.
D) Zoology.
E) Biology.
11. autotrophic organisms capable of producing organic substances from inorganic:
A) consuments.
B) lithotrophs.
C) saprophages.
D) Decomposers.
E) The producers.
12. Omnivorous organisms:
A) detritus.
B) phagocytes.
C) polyphagia.
D) monophagy.
E) Stenofagi.
13. Types, with limited propagation ranges
A) Ubikvisty.
B) Cosmopolitans.
C) Relicts.
D) Violentyev.
E) Endemics.
14. The theory of increasing the population exponentially offered:
A) Yu Odum
B) T. Malthus
C) K. Wylie
D) Darwin
E) VI Vernadsky
15. stagnant water type?
A) Lothic type.
B) Brooks.
C) wetlands.
D) River.
E) The belt type.

THEME 12. GLOBAL ENERGY AND ECOLOGICAL STRATEGY FOR SUSTAINABLE DEVELOPMENT OF THE 21ST CENTURY. ECOENERGETICS

12.1. Ecoenergetics. Non-traditional environmentally friendly sources of energy. Renewable energy sources

12.2. G-global Project, energy saving strategy

12.3 Water is a strategic resource of the 21st century. Water resources management.

At the present stage of the development of civilization, economic growth in any country is closely related to the functioning of the fuel and energy complex. At the same time, the most competitive countries are those where energy resources are used to the maximum extent and with a high degree of efficiency.Energy is now the most discussed concept. In addition to its basic physical content, it also has economic, technical, political and other aspects. Scientists warn that the explored reserves of fossil fuels at the current rate of energy consumption will run out in 50-80 years. Of course, it is possible to switch to other sources of energy

For example, master the controlled thermonuclear fusion. But even if the population of the planet will use only inexhaustible energy resources, it will still not be possible to avoid an ecological catastrophe. Approximately 100 years on our Earth will be generated 1% of the energy coming from the Sun - 1.5 x 10 24 J per year. For this border, one should not step over, otherwise the melting of ice at the poles will begin, the water level in the World Ocean will increase catastrophically. And then the coastal cities and seaside countries will no longer need energy.

This thermal pollution of the planet can be avoided, but if we strictly save energy and use only alternative energy sources. These include: solar and geothermal energy, wind energy and wave energy, as well as tidal and atomic. Unlike fossil fuels, they are not limited to geologically accumulated reserves. And this means that their use will not lead to depletion of stocks.

New energy conversion schemes are united by one term "ecoenergetics", which means any methods of obtaining clean energy that do not cause pollution of the environment.

Solar energy. Solar energy is inexhaustible. There are several ways to use it. Physical methods of assimilating solar energy use galvanic batteries that

absorb it and convert it into thermal or electrical energy, or mirror systems reflecting the rays of the sun and directing them to oil-filled pipes that concentrate solar heat.

The Volgograd region is located in the south of our country, hence, in the long term, the lack of energy without problems can be compensated for by solar energy. But the inhabitants of the Far North, Siberia, Yakutia, etc. in this regard are more difficult. I believe that in this area it is possible to use solar collectors to provide the population with electricity, especially in summer. The use of solar collectors can partially solve the environmental problem and use energy for domestic needs (water heating, heating of greenhouses, etc.). The most successful solar energy is developed in Japan and Israel, where it almost completely covers the need for heating the house and heating the water for domestic needs.

"The joint Algerian-Japanese project Sahara Solar Breeder promises to turn the Sahara desert into a thicket of solar cells capable of providing up to half of the world's electricity needs by 2050" . In principle, solar energy can be used in any corner of the earth. One of the most promising sources of energy on Earth is biomass, since it is available in unlimited quantities. Biomass is divided in to primary and secondary.

Wood, agricultural waste, dried seaweed, which are processed into alcohol, etc., are then used to generate energy. Biological use of solar energy is the production of biogas from manure, which is fermented without access to air. A lot of garbage accumulated in the world, which worsens the environment. Garbage has a disastrous effect on people, animals, birds, on everything living on earth.

Such dumps are near my Gorkovsky village of the Sovetskiy district of Volgograd: behind a railroad slide along the Rostov route in front of the village of Rogachik, in the beam from. Gerbils, at the station. Turquoise, etc. Many spontaneous dumps formed along the beams of the mouth of the Tsarina River. There are a lot of such dumps in all large and small towns and villages of our country. In this regard, I think that it is necessary to develop energy using secondary biomass to prevent pollution of the environment. I had the idea to investigate the dumps of the village, to find out how much garbage is taken out and how much it needs to provide my village with electricity received from the burning of garbage. My calculations showed that the village of Gorky can provide itself with biomass energy at the expense of its own garbage. And with biomass almost all garbage will be burned, and there is almost no waste.

This will solve the problem of destroying garbage and providing the village with electricity at minimal cost. It is perfectly possible to solve this problem in other cities, which is already being successfully solved in Western countries. In the course of the research, I carried out a small sociological survey among the population of the Gorkovskiy village, the results of which showed that the majority of respondents in the poll positively relate to the use of biomass energy.

Benefits of bioenergy

This renewable energy, which does not increase the concentration of carbon dioxide in the atmosphere, solves the problem of using waste (garbage), and, therefore, helps improve the ecology and make the world cleaner.

Solar radiation with the help of solar units is converted into thermal or electric energy, convenient for practical use. Dozens of solar installations and systems have been created in the southern regions of our country.

Advantages of solar energy

Advantages of solar energy are in the general availability and inexhaustibility of the source, in complete safety for the environment, it is an environmentally friendly source of energy, which is very important right now.

Because of the relatively small amount of solar constant for solar energy, it is required to use large areas of land for power plants (for example, for a 1 GW power plant this can be several tens of square kilometers). The flow of solar energy on the Earth's surface depends strongly on latitude and climate. In different places, the average number of sunny days per year can vary very much. The solar power station does not work at night and does not work efficiently in the morning and evening twilight

Use of wind energy

Mankind has learned to use wind energy at an early stage of its development. Wind power plants produce electricity only when a strong wind blows. A modern windmill is a complex device. It is programmed to work in two modes - a weak and strong wind and stopping the engine if the wind becomes very strong. The disadvantage of wind turbines is the noise that produces the propeller blades during rotation. If the windmill is powerful, then noise pollution makes it dangerous for people to stay in the installation area for a long time. The most justified are small windmills to provide cheap and environmentally safe electricity to individual farms and suburban areas.

Among the leading countries in the use of wind energy are: Germany, Denmark, Spain, USA. In Russia over the past 5 years, several wind power plants have been built: in Bashkiria, in the Kaliningrad region, on the

Commander Islands, in Murmansk. The use of wind turbines in the Kalmyk steppes, which border on the Volgograd region, is promising, since there winds blow, as a rule, constantly and only in one direction. At present, wind power plants are widely used there to provide electricity to small towns of Kolmykia. On the outskirts of Volgograd there are also local windmills. Autonomous wind power plants appeared in a remote from the electrical networks of the village. Osipovo, Kalachevsky district, on the shepherds' points in the Volgograd region.

The project of the first wind farm in Russia with a capacity of 1 GW to be built in the Volgograd region is being discussed. The total capacity of wind turbines in Russia exceeded 10 MW. The easiest way to use wind energy for future use is that the wind wheel moves the pump, which accumulates water in the tank above, and then water, draining from it, drives a water turbine and a generator of constant or alternating current. "Development of wind power in a complex with other renewable sources for power supply of isolated settlements far from other energy sources is especially promising".

Disadvantages of wind energy

First of all, wind turbines adversely affect the operation of the television network. Another peculiarity of wind installations was that they proved to be a source of sufficiently intense infrasound noise, unfavorably acting on the human body, causing a constant oppressed state, a strong unreasonable anxiety and vital discomfort.

Advantages of wind energy

Absence of influence on the heat balance of the Earth's atmosphere, oxygen consumption, carbon dioxide emissions, etc. Possibility of transformation into various types of energy (mechanical, thermal, electrical). Unpredictable changes in wind speed during the day and season.

Tidalpowerplants (PES)

"Due to the use of tidal energy in Russia, it is possible to cover more than 25% of the current energy consumption of the country". To generate electricity, power plants of this type use tidal energy. The first such power plant (Pauzhetskaya) with a capacity of 5 MW was built in Kamchatka. For the device of the simplest tidal power plant you need a pool, a dam that is blocked by a dam or a river mouth. In the dam there are culverts and hydraulic turbines are installed, which rotate the generator. According to the principle of operation hydraulic turbines are divided into: active and reactive; by design - on vertical and horizontal. Power of hydro generators from several tens to several hundred MW.During high tide, water enters the pool. When the water levels in the pool

and the sea equalize, the shutters of the culverts are closed. With the onset of ebb, the water level in the sea drops, and when the head becomes sufficient, the turbines and the associated electric generators begin to work, and the water from the pool gradually disappears. In Russia, since 1968, there has been an "experimental" PES in the Kislaya Bay on the coast of the Barents Sea with a capacity of 0.4 MW.

This is the first and so far the only tidal power station in Russia. In 2006, a prototype of a floating unit was installed at the station, on which the original hydroelectric unit OGA-5 with a capacity of 1.5 MW is located. "Since 1966, two French cities have completely met their electricity needs due to tidal power stations" [9, c. 78]. In the Uryupinsky district of the Volgograd region, to illuminate the floating bridge across Hopyor, a mini-hydroelectric power station of wave type was built, which operates on the energy of the water flow. The presence of the Volga, the Don and small rivers dictates the competent use of hydro resources of the Volgograd region.

Disadvantages of tidal power plants

They disrupt the normal exchange of salt and fresh water and, thereby, the living conditions of marine life and fauna. They also affect the climate, because they change the energy potential of sea waters, their speed and the territory of displacement. Marine heat stations built on the difference in temperatures of sea water contribute to the release of a large amount of carbon dioxide, heating and lowering the pressure of deep waters and cooling of surface waters. And these processes can not but affect the climate, flora and fauna of the region.

Advantages of tidal power plants

The advantages of PES are environmental friendliness and low cost of energy production. Does not pollute the atmosphere. Cheap and renewable energy. Reduces the level of extraction, transportation and burning of fossil fuels.

Use of geothermal sources

In this case, the use of heat from the terrestrial depths (deep hot springs) is implied. This heat can be used in almost any area, but the costs pay off only where hot waters are close to the surface of the earth's crust. These are areas of active volcanic activity and geysers, for example, Kamchatka, Kuriles, islands of the Japanese archipelago, Iceland, New Zealand. Geothermal energy sources can be of two types. The first type is underground pools of natural heat carriers - hot water (hydrothermal sources), or steam (steam-source sources), or steam-water mixture. In essence, these are directly ready-to-use "underground boilers", where water or steam can be extracted using conventional boreholes.

The second type is the heat of hot rocks. This makes it possible to get steam or superheated water for further use for energy purposes. But in both applications, the main drawback is a very low concentration of geothermal anomalies where hot springs or rocks approach relatively close to the surface and where, when immersed in depth for every 100 m, the temperature rises by 30-40 ° C, geothermal energy concentrations can create conditions and for its economic use.

Advantages of geothermal sources

First, their reserves are almost inexhaustible. According to the estimates of the late 1970s to a depth of 10 km, they amount to a value that is 3.5 thousand times greater than the reserves of traditional types of mineral fuel. I think that this figure has recently changed in the direction of increase. Secondly, geothermal energy is quite widespread. Its concentration is mainly due to the zones of active seismic and volcanic activity, which occupy 1/10 of the Earth's area. And this is not s little.

Disadvantages of geothermal sources

The main problem is the need for re-injection of waste water into the underground aquifer. The thermal waters contain a large number of salts of various toxic metals (boron, lead, zinc, cadmium, arsenic) and chemical compounds (ammonia, phenols), which excludes the discharge of these waters into natural water systems located on the surface, since these substances have a pernicious action on all life on earth.

Project G-global, energy saving strategy

"G-Global" is a multifunctional Internet platform where world minds are united to discuss global issues of world development, an international virtual project aimed at discussing and developing mechanisms to overcome the global financial crisis. The idea of G-Global belongs to the leader of Kazakhstan Nursultan Nazarbayev, which he proposed in 2012. G-Global in a short time brought together more than 55,000 users from 160 countries. Every day on the resource conditions are created for the world expert community for interactive, open and public discussions on social, economic, political, cultural, demographic and many other issues. The project was supported by: 14 Nobel laureates - Robert Mundell, John Nash, Robert Kornberg, Eric Maskin, John Aumann, Finn Kydland, James Mirrell and others; representatives of international organizations, business, education and science.

On the portal of the international communicative platform G-Global an interactive online conference "Person of the month" with participation of well-known Kazakhstan and foreign personalities is held. On the site you can post

articles, upload reports, participate in discussions and leave your own comments, conduct or join online conferences, ask questions to discuss these activities or create a thematic debate.

President N.A. Nazarbayev proposed five principles of G-Global:

1. Evolution, not revolution. According to the President of Kazakhstan, today all the wisdom of mankind is to preserve our world, and revolutions are permissible only in the sphere of scientific knowledge and technologies.

2. Equality and consensus, i.e. fair basis for a global economy, monetary system and policies based on the equality of all states.

3. Global tolerance and trust. This is one of the levers for bringing the world economy out of the state of recession, and without a global trust of real coordinated anti-crisis solutions it will be impossible to achieve.

4. Global transparency. The world in the format of G-Global is a transparent community of nations; it should not have any double standards that degrade the dignity of nations.

5. Constructive multipolarity, which is the only alternative to challenges and threats. Nazarbayev hopes that one of the successful associations will be the Eurasian Economic Union.

Only on the basis of these five principles in the 21st century is a successful dialogue possible on any global issue and reaching out to solutions acceptable to all participants. Today, the world needs a new financial and economic system and effective global security structures, including nuclear ones.

Creating a sustainable model for the development of the economy of Kazakhstan is impossible without addressing the issues of improving energy efficiency and energy conservation. The policy of effective and rational consumption of energy resources should lead to curbing the growth of their consumption and a significant reduction in the level of environmental impact.

Activities in this area will contribute to the modernization of industry, electricity, housing and communal and transport sectors, by stimulating the use of new technologies and innovations. In this regard, the leadership of Kazakhstan, despite significant reserves of energy resources and developed energy infrastructure in the country, has chosen a course on energy saving and energy efficiency as the main priorities of energy policy. The task is set to reduce the energy intensity of GDP by at least 40% by 2020.

Energy accounts for about 47% of the total consumption of primary energy resources. At the same time, a high share of wear and tear of generating and electric grid equipment is observed in the energy sector, which results in

low efficiency of power generation and a relatively high loss in electric networks.

In the industrial sector, the high level of energy consumption is due, first of all, to the activities of such energy-intensive industries as oil and gas, metallurgy and mining. At the same time, the technical condition of the equipment and the problem of reducing the loading of enterprises significantly affect the efficiency of the industry. A number of legislative restrictions on energy consumption in industry have not yet yielded positive results. The analysis of the approved norms of energy consumption in industry showed their inapplicability to the working conditions of some enterprises, especially in the mining and metallurgical and coal mining sectors. In terms of housing and communal services, most of the existing housing stock consists of apartment buildings with central heating based on boiler houses or CHP. For district heating networks, the current state of the infrastructure is characterized by low efficiency and significant heat losses. On average, residential buildings in Kazakhstan consume three times more energy per unit area than in the Nordic countries. A high level of heat loss is mainly associated with obsolete equipment, as well as lack of proper repair. The transport sector accounts for 17% of the total consumption of the country's primary energy resources, while the technical condition of a part of the fleet of vehicles and the quality of the fuel used, have a significant impact on specific fuel consumption and emissions of harmful substances. The transition to new fuel quality standards, the introduction of modern navigation and information systems will improve the energy efficiency of the transport sector and increase the capacity of the transport system.

Experts of the Energy Charter and Association KAZENERGY prepared recommendations for increasing energy efficiency in the main energy-consuming sectors of Kazakhstan's economy:

- Development of experience in attracting investments in the modernization of obsolete infrastructure in the sectors of production, transmission and distribution of electricity in order to minimize losses.

- Amendments to the legislation to ensure the reliability and quality of electricity supply, providing for increasing the degree of responsibility for non-compliance with the requirements for the quality of electricity, both electric and power grid companies, and large consumers of electricity. It is also recommended to study the issues of certification of electricity.

- Development and adoption of a state program for the modernization and development of electric grid companies with the definition of required

investments and their sources that take into account the main tasks of the industry: reducing losses, improving the reliability and quality of electricity supply, setting requirements for owners by the terms of their achievement with appropriate changes to tariffs.

- Consideration of the possibility of introducing mechanisms for paying for reactive power by large consumers of electricity and giving preferences to power grid companies that reduce losses, to stimulate measures to compensate for reactive power, and to reduce power losses in electric networks.

- Development of incentive mechanisms for energy saving by introducing changes in the rules and procedure for the formation of tariffs.

In the industrial sector, it is recommended:

- Strengthening of the state control and organization of monitoring of the implementation of energy saving plans, compiled on the basis of the results of energy audits.

- Promotion of compliance with ISO 50001 - Energy management by large industrial enterprises.

- Revision or cancellation of approved energy consumption norms, due to their inapplicability to some industrial enterprises.

- Revision of existing standards for industrial equipment in order to promote the application of the best technological solutions in the field of energy efficiency, including modernization and construction of new industrial facilities.

- Development and introduction of various mechanisms of state incentives (voluntary programs, subsidies, soft loans, tax incentives) for industrial enterprises in order to support energy saving and energy efficiency measures.

- Training and retraining of personnel on the basis of the departments of profile institutes and universities in the field of energy saving and energy efficiency, conducting professional trainings, as well as programs on qualification and retraining.

In the housing and communal services sector (including lighting) it is recommended:

- Tougher requirements for energy efficiency of new and existing buildings and allocation of sufficient resources to monitor compliance with legal requirements, as well as building codes and regulations.

- Strengthening the role of author and technical supervision over the progress of construction of buildings and structures.

- Implementation of a system of quarterly heat consumption in new buildings to encourage end-users to regulate their level of heat consumption;

continuation of installation of automatic control systems of heat consumption and house heat meters in existing multi-apartment buildings.

- Encouraging regional and local authorities to develop targeted energy efficiency programs to meet audit requirements and to introduce special criteria for energy efficiency in public procurement procedures.

- Development and implementation of financial mechanisms for end-users, stimulating investment attraction in modernization of existing buildings to increase their energy efficiency.

- In the distribution of thermal energy and gas, it is necessary to establish long-term tariffs at an economically reasonable level, which provides for an investment component in modernization and energy efficiency.

- Strengthening the process of developing and adopting common minimum energy efficiency standards for energy-consuming products within the framework of the Eurasian Economic Union.

- Creation of necessary conditions for support of regional / local authorities in the development and implementation of projects for highly efficient street / urban lighting; the introduction of incentives in the form of grants or subsidies to facilitate the rapid introduction of energy-efficient street lighting throughout the country.

In the sphere of transport it is recommended:

- Carrying out an assessment of the quality of city planning, elements of transport infrastructure and traffic management. It is necessary to create a system of indicators of energy efficiency of the transport sector at the national and regional levels.

- Strengthening of state control in terms of quality of motor fuel supplied to the market.

- Strengthening of state control in terms of quality of motor fuel.

- Implementation of tax and financial incentives to support the use of energy efficient vehicles and vehicles.

- Increasing requirements for relevant government agencies and agencies to improve the quality of services, efficiency, accessibility and comfort of existing public transport systems in order to create alternatives to the use of private cars in urban areas.

- Introduction of navigation and temporary systems in order to optimize the transport logistics sector and increase the energy efficiency of freight transport (including railway transport).

Water is a strategic resource of the 21st century. Water resources management.

When we want to emphasize the value of something, we usually compare it to gold. Cotton is called white gold, the forest is green, and oil is black. The greatest wealth of the earth - bread - is derived from the golden spike. With what to compare the value of ordinary, simple, not to mention mineral, medicinal water. Water is priceless! According to Academician V.I.Vernadsky, "water stands apart in the history of our planet. There is no natural body that could compare with it on the effect on the course of the main, most grandiose, geological processes. "

Where did the water come from? Until now, there is no unambiguous answer to this seemingly simple question. For billions of years of the planet's existence, its oceans might well have been filled with water from volcanic eruptions, which are now delivering millions of tons of water to the surface from the depths of the planet annually. But if we calculate how much meteorites that contain water have fallen to Earth during this time, and how much water has formed on the approaches to the planet the flow of hydrogen nuclei - protons sent by the Sun, and now he gives 1.5 thousand tons of water annually, then the real there will also be a cosmic source. There is a hypothesis that water permeates our entire planet, to its furthest depths, where it actively moves, using phase transitions and the ability to dissolve. It forms a single drainage shell of the Earth, with which deposits of many minerals, especially oil and gas, are directly connected.

The chemical formula of water - H_2O - is striking in its simplicity. However, the seeming so simple water in its structure and properties is a completely unique substance.

Water is one of the most complex substances, both from the physical and chemical points of view. Water refers to substances that are most difficult to obtain in pure form. Pure water is always a mixture of light water (H_2O) and very small amounts of heavy and super heavy water.

Water is a substance whose physical constants differ in the greatest number of anomalies.

1. When heated from 0 to 4° C, the volume of water does not increase, but decreases, and the maximum density is reached not at the freezing point (0° C), but at 4° C.

2. When the water freezes, water expands, and does not contract, like all other bodies, its density decreases.

3. The freezing point of water with increasing pressure decreases, but does not increase.

4. The specific heat of water is extremely large in comparison with the specific heat of other substances.

5. Due to the high dielectric constant, water has a greater dissolving and dissociating ability than other fluids.

6. Water has the largest surface tension of all liquids: $75*10^{-3}$ J / m^2.

One of the reasons for the anomaly is the structural features and the ability of water molecules to interact strongly. Due to the anomaly of water, life on Earth is ultimately ensured. Water, as is known, can be in liquid, solid and gaseous states. It remains a liquid in the temperature intervals most suitable for life processes. For a huge mass of organisms, water is the medium of their life and evolution. At certain times of the year, liquid water can freeze and become covered with ice. When it freezes at 0 ° C, the water turns into ice, and the volume increases by 10%. Freezing goes from top to bottom, ice is lighter than water and floats on the surface. This feature is of great importance for the life of organisms living in water bodies (aquatic systems). If the ice was heavier than water, the ponds would freeze to the bottom and life would freeze in them. High specific heat, slow heating and cooling, along with other factors determine the annual, diurnal and even hourly fluctuations in the temperature of the oceans and lakes. These fluctuations differ markedly from changes in temperature on land. This property of water determines the difference in the temperature regime of soils, and ultimately has a significant effect on the life of aquatic and soil organisms. Life in the water is more diverse than on land.

Natural waters are in complex reversible relationships with organisms, rocks, and the atmosphere. The natural cycle of self-cleaning water - the eternal movement that provides life on Earth - is estimated at 483,000 km. The water vapor present in the atmosphere plays the role of a filter for solar radiation, and water on the earth's surface serves as a kind of powerful buffer system that softens the effect of extreme temperatures.

Water is the main factor determining the climate on the surface of the Earth.

The main role of water is that it is the medium and source of hydrogen for life processes. Virtually all organic substances of the biosphere are a product of photosynthesis, in which plants use light energy to combine carbon dioxide with water. Without water, as is known, photosynthesis can not occur. The process that the entire life of our planet owes. Water is the only source of oxygen released into the atmosphere during photosynthesis. Water is necessary for biochemical and biophysical processes that provide the possibility of life on Earth. Figuratively speaking, life is enclosed in a drop of water.

Figure 39 *- In a drop of water is life*

Water is 89-90% of the mass of plants and 75% of the mass of animals. The composition of the human body is 65% water. Water serves as a constant participant in intensive biochemical processes occurring in the human body. No life process is performed without it. Violation of the water balance leads to serious shifts in the human body. With the loss of 6-8% of moisture from body weight, a person falls into a semi-fainting state, with a loss of 12% or more of a percentage of moisture, death occurs. How much does the human body need water?

Scientists believe that on average, a person needs 2.5 liters of water per day, while one liter is consumed by drinking water. However, under certain conditions, the demand for water increases to 4-5 liters and in hot climate conditions with low air humidity reaches 6 liters or more. A person can live without food for five to six weeks, without water - five days. Here it is appropriate to quote the words of J. Byron: "Without suffering the thirst, it is impossible to comprehend how much water means to people".

The main consumer of water on Earth is humanity and its activities. And it is not by chance that all the great civilizations of antiquity arose and developed near water, in large river valleys. There was not a single great civilization in the area devoid of water.

Summarizing the above, it should be emphasized once again that the water is the custodian and distributor on our planet of solar energy, the main

creator of the climate, the daily weather, the heat accumulator and, what is especially important, the prerequisite of life on the planet. And there is nothing on the Earth that should be treated with more attention and caution than to such a habitual for us water. According to the figurative expression of Academician A.L.Karpinsky, "water is living blood, which creates life where it did not exist".

On April 4, 2014, by the decree of the President of the Republic of Kazakhstan No. 786, the State Program for Water Resources Management of Kazakhstan for 2014-2020 was approved. "The strategic goal of the State Program is to ensure the water security of the Republic of Kazakhstan by improving the efficiency of water resources management." The goal of the program is to ensure the country's water security by improving the efficiency of water resources management.

The tasks are defined in three main areas: guaranteed provision of the population, the environment and economic sectors with water resources through implementation of measures to save water and increase the amount of available water resources; improving the efficiency of water resources management; preservation of water ecological systems.

In the new state program of water resources management, water supply issues were considered in a comprehensive manner, taking into account the goals and objectives of sustainable development and the transition of our country to a "green" economy. So, one of the indicators of the program considers the issues of water supply of the environment along with water supply to the population and economic sectors. This is an important factor in ensuring Kazakhstan's socio-economic development along a stable and balanced trajectory.

The analytical section of the program identifies the main threats to ensuring water security. Thus, under the most unfavorable scenario, which includes the consequences of climate change, an unprecedented increase in water withdrawal by neighboring countries, irrational use of water inside the country (water losses reach up to 50-60%), by 2040 the water deficit in Kazakhstan can reach the indicator in 12 cubic kilometers per year. Therefore, Kazakhstan, which sets a strategic goal of becoming one of the thirty most developed countries in the world, has developed new approaches to implementing the state policy on water resources management.

The State Program proposes a set of measures to prevent water shortages in Kazakhstan.

First of all, it is expected to implement the most effective initiatives in a number of areas.

The state program provides for the launch of a mechanism to stimulate the rational use of water resources. For example, in agriculture - this is a revision of the composition of cultivated crops to reduce water consumption, a survey of the state of irrigation infrastructure and farmland, irrigation methods and agricultural practices used, rehabilitation of infrastructure, the introduction of modern technologies for soil treatment and irrigation methods, etc.

In addition, the program provides for the implementation of measures aimed at achieving equitable water allocation of Transboundary Rivers. These are measures to strengthen negotiating groups, make forecasts, develop a negotiating strategy, establish an infrastructure for monitoring transboundary water flows, and conclude agreements on transboundary waters.

Regulation of inland water resources will be carried out through the implementation of critical projects for the country to restore and improve the water infrastructure.

In addition, a set of measures to improve the water management system, as well as tariff policy and regulation.

As a result of the implementation of the measures proposed by the state program, a saving of 9.5 cubic kilometers of water per year will be ensured. At the same time, the first 2.6 cubic kilometers (or 21% of the deficit expected by 2040) will be saved as a result of self-supporting measures without increasing the tariffs for water. Accordingly, the increase in tariffs in the implementation of self-sustaining measures can increase water savings.

The implementation of the proposed measures will by 2020 reduce water consumption per unit of GDP by 33% from the level of 2012, and this is one of the main indicators of the implementation of the State Program.

The implementation of all the directions proposed by the state program will require the attraction of a significant amount of financial resources.

Test tasks for self-control:

1. Unified measure of water use in populated areas:

A) m3 / day;

B) l / day;

C) m3 / year;

D) m / min;

E) l /year.

2. Under the catchment basins understand:

A) the territories from which water flows into certain water bodies;

B) the territories from which water flows into all water bodies;

C) the territories from which industrial waste water flows into certain ponds;

D) the territories from which water flows into canals;

E) the territories from which water flows into sewer pipes.

3. Freshwater ecosystems include:

A) chaparral;

B) the lake;

C) tundra;

D) the open ocean;

E) estuaries.

4. Marine ecosystems include:

A) the lake;

B) desert;

C) open ocean;

D) swamp;

E) chaparral.

5. The Lenthic type of water is:

A) springs;

B) river;

C) streams;

D)brook;

E) open ocean.

6. To Lothic waters are:

A) reservoirs;

B) lakes;

C) rivers;

D) the open ocean;

E) ponds.

7. Anthropogenic natural complexes are:

A) parks and a reservoir;

B) river valleys;

C) lakes and swamps;

D) forests;

E) the occans.

8. Aggregate state of water:

A) liquid. solid and different;

B) liquid and different;

C) liquid and solid;

D) liquid, solid, gaseous;
E) solid and gaseous.
9. What type of ecosystems are flowing waters?
A) The ocean.
B) Lenthic type.
C) The Lothic type.
D) of the lake.
E) swampy grounds.
10. Which type of ecosystems are stagnant waters?
A) forest.
B) Lothic water.
C) mountains.
D) Lenthic water.
E) rivers.

THEME 13. ECOLOGICAL POLICY OF THE REPUBLIC OF KAZAKHSTAN. THE CONCEPT OF SUSTAINABLE DEVELOPMENT OF THE REPUBLIC OF KAZAKHSTAN

13.1. Actual ecological problems of sustainable development of the Republic of Kazakhstan

13.2. The concept of sustainable development of the Republic of Kazakhstan

13.3. Ecological Code of the Republic of Kazakhstan. Legal basis for environmental management in Kazakhstan

13.4. The main strategic directions of the Republic of Kazakhstan for improving the environment

Actual ecological problems of sustainable development of the Republic of Kazakhstan

The Republic of Kazakhstan, one of the ten largest countries in the world, is characterized by complex natural and climatic conditions. The territory is extremely remote and has no access to the world ocean, is represented in many respects by desert and semi-desert landscapes. The climate of the republic is sharply continental, arid. The hydrographic network is strongly rarefied; the volumes of the watercourses are unstable. Kazakhstan is a storehouse of many minerals. More than 300 species are produced in the country. In the depths of 99, explored reserves of 70, involved in the production of more than 60 elements of the periodic table. The global reserves of chrome ores (about 30% of the world), manganese and uranium (25%), lead (19%), zinc (18.9%), titanium (2.5%), copper and iron - 10% gas (1.6%), iron ore reserves - 3.8% of the world.

In Kazakhstan per capita is extracted about 50 tons. various substances (in Europe, an order of magnitude less). Of this amount, up to 93-95% is emitted into the environment as production and consumption waste that poses a threat to public health and the biodiversity of the nature management region.

The rich resource and raw materials potential was in the Soviet era the basis for the development of a powerful industry and a number of strategically important industries. At the same time, the extensive nature of conducting economic activities and ignoring the foundations of nature management have led to serious changes in the natural environment of Kazakhstan. Industrial enterprises were the main sources of pollution and destruction of the

environment, and in a number of regions of the country identified a catastrophic environmental situation.

Table 11 - **Priority environmental problems of the Republic of Kazakhstan and ways to solve them**

№	Ecological problems	Technical and technological basis of environmental optimization
1	2	3
1	Pollution of the air basin of cities and industrial centers, the risk of acid rain	Introduction of low-waste industrial technologies, effective filters for air purification, improvement and streamlining of motor vehicles, landscaping
2	Pollution of surface and groundwater sources	Introduction of effective water treatment systems, recycled water supply
3	Accumulation of industrial and domestic wastes	Low-waste production, waste utilization, waste processing
4	Change in the geochemical background of soils in urban industrial complexes	Control over emissions of industrial enterprises and vehicles, land reclamation
5	Soil degradation and desertification of landscapes	Anti-erosion soil treatment systems, reclamation of disturbed lands in industrial landscapes, landscaping
6	Degumification and salinization of soils	Introduction of modern agro technical methods of soil cultivation, crop rotation
7	Nuclear pollution	Reclamation of disturbed lands, backfilling of treated quarries with waste rock, zoning of hazardous areas
8	Reduction of the area of forests and green spaces	Prevention of illegal logging, expansion of forest management
9	Loss of biodiversity	Fighting poaching, preserving characteristic biotopes, protecting rare species of animals and plants
10	The desiccation of the Aral Sea	Improving the water use regime of water consumption in theriver. SyrDarya
11	The fluctuation of the level and pollution of the Caspian Sea	Improvement of oil and gas production, prevention of oil spills within the Caspian Sea shelf

Of all the regions of Kazakhstan, six have been identified as the most unfavorable in terms of ecology. Of these, three zones were identified, representing priority environmental problems.

1. (Pre-Caspian) - areas: Atyrau, Mangistau. The main environmental priority is oil pollution (water, air, desertification, loss of biodiversity).

2. (Eastern) - area: East Kazakhstan. Pavlodar. Karaganda, Akmola. The main environmental priority is industrial pollution (water, air, forest degradation, waste management).

3. (South) - areas: Almaty, South Kazakhstan, Zhambyl, Kyzylorda). The main environmental priority is irrational water use (water pollution, desertification, water scarcity).

The concept of sustainable development of the RK

The Republic of Kazakhstan, being a full-fledged participant of the world community, assumed the obligations to fulfill the tasks set in the Agenda 21 (Rio de Janeiro, 1992) and the declarations of the Millennium Summit (New York, 2000) and the World Summit on Sustainable Development (Johannesburg, 2002). The Government of the country, since 1996, has taken a number of measures towards achieving sustainable development (SD). At the global level, the republic is an active participant in the processes "Environment for Europe" and "Environment and sustainable development for Asia", at the regional level - participates in the preparation of the Regional Central Asian Action Plan for Environmental Protection and actively supports the process of preparation of the Central - Asian Sustainable Development Strategy (Subregional Agenda-21), at the national level - adopted the Development Strategy of Kazakhstan until 2030, the Strategy of industrial-innovative development to 2015, the Concept of Environmental Security of the Republic of Kazakhstan until 2015, the Council for Sustainable Development of the Republic of Kazakhstan was established.

At the same time, the processes of globalization and integration into the world economy require an active policy in the field of sustainable development. In this regard, the present Concept of the Transition of the Republic of Kazakhstan to Sustainable Development until 2015 (hereinafter the Concept) is aimed at enhancing the policy on sustainable development at the national and regional levels of the country's development.

Kazakhstan is an active participant in regional cooperation in the field of environmental protection and development - within the framework of the International Fund for Saving the Aral Sea (IFAS) and its working bodies. The Interstate Commission for Water Coordination (ICWC) and the Interstate

Commission for Sustainable Development (ICSD). In the structure of ICSD from the countries of Central Asia in accordance with the integration approach, representatives of the ministries of economy, environmental protection and scientific organizations work. Kazakhstan participates in the development of the Central Asian Regional Action Plan for Environmental Protection. In order to strengthen the contribution of civil society and NGOs to the joint solution of regional environmental problems and sustainable development problems, in 2000 the Central Asian Regional Environmental Center was established in Central Asia by the initiative of the Central Asian countries.

Kazakhstan actively participated in the development of the Framework Convention for the Protection of the Marine Environment of the Caspian Sea, which was successfully adopted in the autumn of 2003. In addition, the republic participates in the development of the Environmental Strategy for Eastern Europe, Caucasus and Central Asia (EECCA).

In Kazakhstan, work is constantly being done to strengthen social integration and partnership, as well as to involve all sectors of society in discussing issues of sustainable development and environmental security. As part of this work, a number of conferences, forums, seminars, roundtables with the participation of representatives of the Parliament of the Republic of Kazakhstan, ministries and departments, academic institutions, akimats, NGOs, private sector, as well as international organizations were held in the republic. The past conferences and seminars, widely covered in the media, played an important role in the preparation of public opinion and propaganda of the ideas of sustainable development, served as an impetus to the formation of state and public structures in this sphere, and also attracted the attention of the government and international organizations.

The main goal of the SD concept is to identify the priorities for integrating the principles of sustainable development into the processes of managing the national economy by overcoming interdepartmental barriers and developing partnerships to improve the quality of life of present and future generations of Kazakh people.

This Concept should lay the foundation for the development of the National Sustainable Development Strategy of the Republic of Kazakhstan.

Objectives of the Concept:

• Introduction of the principles of sustainable development in the planning processes of the national economy;

• introduction of a balanced, integrated approach to the process of making managerial decisions;

• Improving the system of managing the process of sustainable development by overcoming interdepartmental barriers and strengthening intersectoral partnerships;

• achievement of synergetic effect of interaction of social, economic, ecological and institutional sectors of the general life support system.

Principles and priorities of the concept of sustainable development of the republic of kazakhstan

The concept is based on the following principles:

1) Intersectoral partnerships and interagency coordination;

2) A balanced approach to solving economic, environmental and social problems, based on the use of SD indicators.

The first principle - involves voluntary interaction of all sectors of society to achieve the goals of sustainable development (SD) within its competence. (Competence is the role, resources and responsibility that each stakeholder takes in the partnership). Each sector has its own motives and its own interest in achieving the goals and priorities of SD.

They allow:

1) the government of the country best perform the tasks of public administration;

2) business has an attractive image, both for consumers and investors;

3) civil society be involved in the process of making managerial decisions.

The *second principle* is to take into account the interrelated environmental, economic and social development goals through the use of a special system of sustainable development indicators that will assess the achievement of sustainability at the national and regional levels and monitor progress against other countries. Indicator of sustainable development is a specific indicator that characterizes the peculiarities of socio-ecological and economic development of the system (industry, region, enterprise) and is a measurable part of it. The introduction of sustainable development indicators in the medium- and long-term planning processes and in the practice of national statistics will allow the introduction of a balanced approach development of country development programs.

Taking into account the interests and peculiarities of the country, the following priorities are defined:

1) Poverty reduction and resolution of demographic problems;

2) Conservation and restoration of national ecosystems;

3) Changes in production and consumption patterns;

4) Introduction of SD principles at the regional level;

5) Improvement of intersectoral cooperation and improvement of interdepartmental coordination and management of the SD process;

6) Using the potential of international trade for SD;

7) Strengthening global partnership and cooperation.

Ecological Code of the Republic of Kazakhstan. Legal basis for environmental management in Kazakhstan

The Ecological Code is a general law that addresses a variety of environmental and climate issues. It codifies ecological definitions of terms into law, establishes the authority of the government to regulate different aspects of the natural environment, stipulates various institutional relations between governmental departments, and lays the groundwork for environmental impact studies among many other regulatory provisions. It includes provisions related to climate change and an amendment passed in 2011 allows Kazakhstan to operate a national carbon trading scheme.

It states that the state shall prioritise prevention and mitigation of climate change and regulate according to principles that limit the amount of GHGs released into the atmosphere. The law authorises a governmental body to monitor climate change and ozone layer and further charges that body with using scientific information to develop measures at the national level specific to various economic sectors to reduce the discharge of GHGs into the atmosphere.

The law also outlines the regulatory authority of the state of Kazakhstan to issue limits (quotas) on the emissions of GHGs and ozone-destroying gases. The regulatory authority lies with a government body to be specified by the state, which will determine maximum quotas, and issue permits for the import of substances harmful to the ozone. The details of the carbon trading scheme were not included in the amendment but issued in a series of executive decrees.

The environmental code is designed to solve the following important tasks:

1. generalization and systematization at the legislative level of issues of environmental protecti

2. Raising the status of environmental requirements and standards to the level of legislative acts of direct action;

3. Implementation of international standardsin the practice eofenvironmental protection in our country.

4. About 20 leading and recommendatory documents of various international organizations, 18 international conventions, about 30 EU directives and legislative acts of foreign states, a draft model code of the Commonwealth of Independent States, and more than 200 regulatory legal acts of Kazakhstan legislation were used in the development of the Environmental Code.

5. The environmental legislation of the Republic of Kazakhstan is based on the Constitution of the Republic of Kazakhstan and consists of this Code and 50 other regulatory legal acts of the Republic of Kazakhstan.

6. If an international treaty ratified by the Republic of Kazakhstan establishes rules other than those contained in the Code, the rules of the international treaty are applied.

7. In the event of a conflict between this Code and other laws of the Republic of Kazakhstan, which contain norms regulating relations in the field of environmental protection, the provisions of this Code shall apply.

8. Relations in the field of protection and use of environmental objects and specially protected natural areas are regulated by special laws of the Republic of Kazakhstan in the part not regulated by this Code.

9. The Environmental Code regulates relations in the field of protection, restoration and preservation of the environment, use and reproduction of natural resources in the implementation of economic and other activities related to the use of natural resources and environmental impact within the territory of the Republic of Kazakhstan.

10. The parties to the relations regulated by this Code are physical and legal persons, the state, as well as state bodies exercising state regulation in the field of environmental protection and public administration in the field of the use of natural resources.

The Constitution of the Republic of Kazakhstan and the Civil Code of the Republic of Kazakhstan determine the general content and forms of ownership of natural resources and other property. In the environmental legislation specific features and forms of ownership of specific natural resources are fixed, as well as features of the mechanism for exercising the powers of the owner of land, water, mineral resources, etc.

Subjects of ownership of natural resources:

- state, individuals, legal entities and executive bodies. Ecological use is divided into three main groups: depending on the object (general, special);

depending on the subjects (organization and citizens); depending on the type of operated natural objects (land use, forest use, subsoil use, etc.).

Under nature management is the use of useful for human properties of the surrounding natural environment - ecological, economic, cultural, and recreational. Allocate general and special nature management.

General nature use does not require any special permission. It is carried out by citizens due to the natural (humanitarian) rights that arise and exist as a result of its birth and existence (use of atmospheric air, water for drinking, domestic and medical and recreational needs, etc.).

Special nature use is recognized as such that is realized by citizens and economic entities on the basis of the permits of the competent authorities of the state. It has a targeted nature and is divided into the types of objects used for land use, subsoil use, forest use, water use, use of wildlife (wild animals and birds and fish stocks), use of atmospheric air. Special nature management is associated with the consumption of natural resources. In this part, it is correlated through legal regulation with sectoral natural resource legislation by the Land, Forest, Water Codes, the Subsoil Law, and the Law on the Protection, Reproduction and Use of Wildlife, the Law on the Protection of Atmospheric Air.

Under special nature use, natural resources are provided to nature users in the established order. The right of special nature use may be permanent or temporary, alienable or inalienable, acquired for compensation or free of charge, primary or secondary. For example, in accordance with Part 8, paragraph 3 of Art. 107 of the Land Code in settlements to general land use include lands occupied and intended for occupation by squares, streets, sidewalks, driveways, roads, embankments, parks, squares, urban forests, boulevards, ponds, beaches, cemeteries and other objects intended to meet needs of the population (water pipes, heating pipes, treatment plants and other engineering systems of general use).

Principles of nature use: the production of rights of use; rational nature management; ecosystems; target use; sustainability of the right to use nature; payment for nature use.

State regulation and management of environmental management and environmental protection is expressed in three forms: law-making, law enforcement and law enforcement.

Management methods: imperative, recommendatory, authorization, permission.

System of state bodies regulation of environmental management and environmental protection: bodies of general competence; bodies of special competence; bodies of inter-sectoral competence; functional bodies.

The object of legal regulation of the state is nature (environment) and its individual elements - land, mineral wealth, water, etc., so we can say that the subject is public relations about nature or the environment.

Types of environmental control: state; departmental; industrial; public.

Forms of environmental control: integrated; complex; differentiated.

Types of environmental expertise: state; public; scientific; normative; sanitary; legal.

Monitoring of the natural environment includes the following elements: a system of a nationwide environmental monitoring service (republican, territorial, regional authorized bodies, posts, stations, observation centers); monitoring of natural objects.

Ecological and legal responsibility is a complex institution of environmental law that regulates legal relations arising and associated with the application of sanctions for environmental offenses between the body authorized to apply sanctions and an environmental offender.

Types of environmental liability: criminal, administrative, civil, disciplinary, material.

Test tasks for self-control:

1. According to the norms of the current environmental legislation, the citizens' right to receive information on the state of the environment is guaranteed:

a) only in respect of the information about the place of residence of a citizen;

b) except the information constituting a trade secret;

c) only in respect of information on transport and industrial facilities;

d) in full without limits.

2. Nature users ... subject to the payment for environmental pollution in its entirety.

a) are exempted from the implementation of environmental protection measures;

b) shall be exempt from compensation for environmental damage;

c) are eligible for a deferral of tax payments;

d) none of the above options is correct.

3. Environmental certification in order to ensure environmentally safe implementation of economic and other activities in the territory of Kazakhstan

a) is carried out only on a mandatory basis;

b) is financed by the Government of the Republic of Kazakhstan;

c) is produced only on the basis of international standards;

d) can be voluntary.

4. When placing the buildings, structures and other facilities should be provided ...

a) execution in the field of environmental protection requirements;

b) restoration of the natural environment and reproduction of natural resources;

c) compliance with environmental safety, taking into account the remote demographic consequences of the operation of these facilities;

d) the lack of sources of drinking water supply in the immediate vicinity of these facilities.

5. For violation of legislation in the field of environmental protection, responsibility is established:

a) material;

b) disciplinary;

c) administrative;

d) criminal.

6. State inspectors in the field of environmental protection in the performance of their official duties within their authority shall not have the right to visit for verification purposes:

a) objects subject to state protection;

b) objects of the defense complex;

c) commercial enterprises;

d) none of the above options is correct.

7. Violation of the rules for the operation of equipment for the control of emissions of harmful substances into the atmospheric air can entail for legal entities ...

a) imposition of an administrative fine;

b) administrative suspension of the enterprise;

c) criminal liability of the director;

d) cancellation of authorization for the emission of pollutants into the atmosphere.

8. State ecological expertise should be conducted ...

a) before deciding on the implementation of the facility;

b) before the official delivery of the object to the customer;

c) before putting the object into operation;

d) before the public environmental review.

THEME 14. SOCIAL ASPECTS OF SUSTAINABLE DEVELOPMENT

14.1. Human rights. Wealth and poverty. Fighting poverty and preventing social stratification. System of social protection of the population

14.2. Improvement of the nation. Formation of a healthy lifestyle. Personal and family health

14.3. Formation of ecological culture

Human rights are the inalienable rights of every person, regardless of nationality, domicile, sex, ethnicity, color, religion, language or any other characteristics. All people equally enjoy human rights, excluding all kinds of discrimination. These rights are interrelated, interdependent and indivisible.

Universal human rights are often fixed and guaranteed by law in the form of treaties, customary international law, general principles of law and other sources of international law. International human rights law places obligations on States to carry out activities with a view to promoting and protecting human rights and fundamental freedoms.

Poverty is the economic and social state of people who have a minimum amount of money, education, power and prestige. Poverty is not only the minimum income (at the level of the subsistence minimum), but also a special image and lifestyle, stereotypes of perception and psychology. Therefore, poverty is spoken of as a special culture, a "culture of survival". Under the Soviet regime in the 1970s and 1980s, the majority of the population belonged to the middle class.

This was promoted by low prices for most food products, goods of public demand, the existence of public consumption funds. In the 1990s.this majority has fallen to the poverty line. To the "new poor" is now considered the most educated part of society, which in the developed countries enters the middle strata (teachers, doctors, engineers, cultural workers). However, in the future, as the public modernization and stabilization of economic and political relations deepen, only educated people will advance. In addition, the high cultural potential and professionalism will sooner or later be claimed by the state.

Otherwise, the upside will be the tendencies of the destruction of statehood. Absolute poverty means a state where an individual can not satisfy even basic needs for food, housing, clothes, warmth, or is able to satisfy only minimal needs that ensure biological survival. The poverty threshold (the

subsistence level) is a numerical criterion. Relative poverty is understood as the inability to maintain a level of decent living or some standard of medium-sized living adopted in a given society. Relative poverty shows how poor you are compared too there people.

Poverty is extreme poverty, beggars can only satisfy physical needs at the lowest, primitive level: they live off handouts, begging, petty theft, pensions below the subsistence minimum, unemployment benefits. Poverty and poverty are to some extent observed in all modern societies, but the highest level of both is characteristic still for the so-called countries. third world (developing countries of Asia, Africa, Latin America).

Fighting poverty and preventing social stratification. The fight against poverty or its prevention is the most important task of any socially oriented economy. In the world practice, two main methods are widely used. The first way is to ensure and maintain a minimum income (wages and pensions), sufficient to maintain the existing in the country consumption standards.

Such a method has found application in developed countries with a high level of well-being.

Another way involves using targeted social assistance for those who are in a situation that is substantially worse than other citizens. It is used in developing countries where the incomes of the bulk of the population are low, and the distribution of social assistance (food, medicinal, household, etc.) is the main method of social support for a large part of the population of the country.

An example of the first model is France, where the state's share in the system of struggle and poverty prevention is very significant. In this country, for all employers, a mandatory minimum wage is set at a level sufficient to meet the basic needs of the worker who is regularly indexed. In addition, the compulsory social insurance scheme, which provides high labor pensions, unemployment benefits, child benefits and benefits, as well as high-quality medical care, is widely used to combat poverty. A special role in France is played by social services in municipalities. In the event that a person has no insurance record (youth, women with children), and also due to special life situations and circumstances (loss of breadwinner, incapacity, etc.), he has the right to submit an application to the municipality, after which he will be provided with the necessary help, and not only material, but also psychological, human rights and so-called.

In the United States, assistance to the poor is provided through special programs that cover 15-20% of the population. The main social groups that receive subsidies are families with young children, primarily one parent or

unemployed breadwinner, people over 65, disabled, blind, war veterans and their families, low-income workers (through tax breaks), and all citizens who have income below a certain level. In the United States, widespread assistance was received in kind: coupons for food, cheap housing, medical care for the elderly, caring for minors and other types.

In post-socialist countries, the guaranteed subsistence minimum, corresponding to the level of the minimum pension, is established only in the Czech Republic. Those citizens whose incomes are below the subsistence minimum receive cash benefits. Only those who claim the absence of a minimum guaranteed income (its value below the physiological level) and the absence of sources of other income (savings, its business, surplus living space) can count on social assistance in Bulgaria.

1.2. System of social protection of the population: concept, basic functions and principles

Social protection of the population is a necessary element of the functioning of any sufficiently developed state. The concept of social protection arose in the late XIX - early XX century, and the corresponding term first appeared in the US in the 30's., and gradually spread in Western sociology, denoting a system of measures that protect any resident of the country from economic and social disadvantage due to unemployment, loss or a sharp reduction in income.

In the 20th century, when the traditional capitalist society was actually transformed into a new social and economic system - a socially-oriented market economy, within the framework of this transformation, powerful social protection systems for the population, covering both the society as a whole, and enterprises, firms, joint-stock companies, cooperatives , labor organizations, etc. We can say that in the West to this day there are several models of social protection systems for citizens. The American, European, and Japanese models are singled out, within which there are different versions.

The system of social protection of the population can be considered in several aspects: as a set of social guarantees and measures for their implementation aimed at ensuring a decent level and quality of life; as a combination of the relationship between the subject and the object of social protection regarding the prevention and elimination of the consequences of socially risky situations by ensuring a decent level and quality of life; as a set of bodies, institutions and organizations that organize and provide social services to the population in the field of social protection.

Forms of social protection of the population can be classified on various grounds: depending on the subject-recipient of social protection - general (directed to the entire population), special or categorical (directed to certain categories of citizens) and exceptional (provided in special cases, on the basis of special regulatory acts (support for people affected by natural disasters, natural and man-made disasters, etc.), depending on the availability of an intermediate link in the assistance system or on Provision - direct (directly provided to citizens in the form of payment of pensions, benefits, social services, etc.) and indirect (eg granting benefits) social protection.

The social protection system performs several important functions:

- Preventive (prevention of socially-risk situations). Examples of the implementation of this function are measures to ensure employment, protect the savings of citizens, prevent emergencies of all kinds, etc..;

- Provisional, in case if it was not possible to prevent the onset of unfavorable social and economic consequences, the state assumes obligations on material support of citizens: pays pensions, benefits, provides various types of social services. This function is implemented by the methods of the social security system:

- compensation, in cases when the citizen was materially or morally harmed in connection with the illegal actions of state bodies, there is a need for his compensation (for example, compensation to liquidators and victims of radiation exposure as a result of the Chernobyl nuclear power plant accident).

The following are the main principles of social protection: social protection should be built into the system of economic relations, can not be limited to guarantees only in one sphere of life; social protection must be based on national and cultural traditions of peoples, take them into account; social protection should be based on a principle of thinking that is aimed at the formation of elements of self-protection of citizens.

Improvement of the nation. Formation of a healthy lifestyle. Personaland family health

Kazakhstan's nation to ensure sustainable development needs a cardinal solution to the task of creating a healthy lifestyle, which involves the implementation of the following measures:

- restriction of tobacco smoking, sale of tobacco products in general trading halls, prohibition of smoking in public places and advertising of tobacco

products, anti-tobacco company in the media, stimulation of quitting smoking in "influence groups" - among doctors, civil servants, educators;

- restriction of alcohol consumption, especially strong drinks, prohibition on advertising of strong spirits, toughening of the control over quality of alcoholic drinks;

- intensification of the fight against drug addiction and drug trafficking, including the promotion of drug rejection and the formation of public anti-drug immunity; improving nutrition standards, increasing the consumption of natural juices and dairy products per capita, promoting healthy nutrition, strengthening control over the quality of food in the domestic market;

- Increase of motor activity, including expansion of the network of free sports and gyms, children's sports sections, stimulation of motor activity and healthy lifestyle through social advertising;

- providing a systematic approach to work on the introduction of the principles of a healthy lifestyle and the formation of citizens of the country's perception of sport and active types of ecological tourism as a new ideology for improving the quality of life of Kazakh people.

In the President's Address "The New Decade - New Economic Growth - New Opportunities of Kazakhstan", the principle of shared responsibility for health and the promotion of healthy lifestyles are identified as the main priorities of health care. The goal is to cover up to 30% of citizens and 15% of children and teenagers with physical training and sports.

A healthy lifestyle is:

- high-grade rest;
- active life position;
- job satisfaction;
- physical and spiritual comfort;
- a harmonious atmosphere of life;
- high medical activity;
- economic and material independence;
- psycho-physiological satisfaction in the family;
- regular physical and motor activity.

A healthy lifestyle is maintained primarily in the family. The family compensates for the shortage of close human communication, creates a comfortable moral climate for him. The family needs to plan fertility, health.The person gets the opportunity to realize himself in labor. Cultural needs are met through visits to concerts, theaters, cinemas, museums, etc.

Along with the above conditions, the most important, and probably the fundamental prerequisite for the successful solution of modern environmental problems is the formation of the ecological culture of the population and, in particular, environmental education and the upbringing of the younger generations.

In philosophy, culture is defined as a specific way of organizing and developing human life activity, represented in the products of material and spiritual labor, in the system of social norms and institutions, in spiritual values, in the totality of relations between people and nature, between themselves and themselves.

As Girusov notes, culture is customarily defined through contrasting it with natural phenomena, since one of the most important manifestations of culture is the imprint of the conscious activity of the subject as opposed to the natural being of natural bodies. However, in reality, in the process of the evolution of society, there is an ever-growing mutual interpenetration and mutual conditioning. Culture is a manifestation of conscious activity; it characterizes the degree of freedom of the subject in relation to natural and social necessity.

Culture as a social phenomenon can be defined in the most general form as a way of life for man and society. And in this its status, culture is an important component and an indicator of the level of development of human civilization.

Modern society faced a choice: either to preserve the existing way of interaction with nature, which could inevitably lead to an ecological catastrophe, or to preserve the biosphere suitable for life, but for this it is necessary to change the existing type of activity. The latter is possible if the people's world outlook is fundamentally restructured, the values in the field of both material and spiritual culture are broken, and a new ecological culture is formed.

Hence it follows: ecological culture is an organic, integral part of culture that encompasses those aspects of thinking and human activity that are related to the natural environment. Man acquired cultural skills not only and not so much because he transformed nature and created his "artificial environment". Throughout the history of civilization he, always being in this or that environment, studied with her. With the greatest reason, this statement applies to the present, when it is time to synthesize the social and natural principles in culture on the basis of a deep understanding of nature, its intrinsic value, the

urgent need to form in man a respectful attitude to nature as an indispensable condition for its survival.

Therefore, the most important indicator of the level of culture of society should be considered not only the degree of its spiritual development, but also the extent to which environmental principles are implemented in people's activities to conserve and reproduce natural resources.

From the point of view of culturology, ecological culture is a component of the culture of society as a whole and includes assessment of the means by which a person's direct impact on the natural environment is carried out, as well as the means of spiritual and practical development of nature (relevant knowledge, cultural traditions, values, etc.).

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Test tasks for self-control:

1. The system of long-term observations, assessment, monitoring and prediction of the state of the environment and it's individual objects is...

a) environmental monitoring;

b) ecological examination;

c) ecological forecasting;

d) ecological rationing.

2. Preparation of environmentally-trained professionals in various fields of activity is achieved through ...

a) the system of environmental education;

b) self-education;

c) wide educational work on ecology;

d) participation in the public ecological movement.

3. Verification of compliance with environmental requirements for environmental protection and ensuring environmental safety at economic sites is...

a) an environmental control;

b) ecological examination;

c) the environmental impact assessment;

d) regulating the flow of pollutants into the environment.

4. The type of responsibility that is provided for non-compliance with standards and other environmental quality standards is called ...

a) criminal;

b) administrative;

c) material;

d) disciplinary.

5. The objects of global monitoring are ...

a) agro-ecosystems;

b) animal and plant life;

c) groundwater;

d) storm sewage.

6. Monitoring of the state of the environment with the help of living organisms is called ... monitoring

a) biospheric;

b) biological;

c) natural and economic;

d) Impact.

7. Assessment of the level of possible negative impacts of planned economic and other activities on the environment, natural resources and human health is

a) ecological expertise;

b) environmental auditing;

c) environmental monitoring;

d) environmental control.

8. Territories and water areas, which are completely withdrawn from normal economic use in order to preserve the natural complex in a natural state, is ...

a) wildlife sanctuary;

b) national parks;

c) natural parks;

d) wet natural (biosphere) reserves.

9. Relatively large natural areas and water areas with zones of economic use, where environmental, recreational and scientific purposes are provided ...

a) national parks;

b) natural parks;

c) wildlife sanctuary;

d) monuments of nature.

10. Territories that have a special ecological and aesthetic value, with a relatively mild protection regime ...

a) natural parks;

b) wildlife sanctuary;

c) monuments of nature;

d) conservancy area

THEME 15.GLOBAL PARTNERSHIP FOR SUSTAINABLE DEVELOPMENT

15.1. Development of civil society. Activities of non-governmental organizations

15.2. Preservation of peace and international security

15.3. Implementing the concept of sustainable development at the global level

15.4. International eco-policy of the Republic of Kazakhstan

15.5. International conferences on environmental protection

The very concept of "civil society" dates back to the period of antiquity. It was introduced into scientific circulation by the great ancient Greek philosopher Aristotle: "Before determining what a state is, it is necessary to clarify the concept of a citizen, for the state is nothing other than the aggregate of citizens, the civil community". This approach, in which the state and society were viewed as a single whole, persisted until the 18th century, when in its main features civil society began to form in its modern sense. The basis of this phenomenon is the process of gradual elimination of the ancient idea of identity of personal and public, private and public, the establishment of the idea of the primacy of society in relation to the state. The modern understanding of civil society is based on the fact that it consists of a complex of individuals, classes, groups, corporations, estates, institutions whose interaction is governed by civil law and which do not directly depend on the state itself. In other words, civil society includes all part of society that is not directly covered by the state, its structures.

At the same time, civil society is not only something different from the state; it is closely connected with it. That is why it forms the natural foundation of political democracy, without which the latter is simply impossible or ineffective.

At the center of civil society is a sovereign personality with various rights and freedoms, especially such as the right to life, property, freedom. In these conditions, a person's behavior is determined by his own interests, while at the same time all responsibility for his actions falls on him. Such a person values his own freedom above all, respecting, at the same time, the legitimate interests of other people.

In general, analyzing various historical concepts and practical models of civil society, it can be characterized as a system of state institutions and relations independent of the state, which are designed to provide conditions for self-realization of individuals and collectives, the realization of private interests and needs. This ability of society to self-organization is possible only if there are certain economic conditions, namely economic freedom, the variety of forms of ownership, market relations. Private property is the basis of civil society. It allows the members of civil society to maintain economic dignity.

In solving the key tasks of civil society formation, a significant role is played by non-governmental organizations that form the so-called third sector, which is intended to emphasize its importance along with two other state-representing and purely market structures.

The third sector is formed on the principle of self-government, as a result of citizens' activity "from below." This is a rather vague category and a collective notion to which state-independent (non-governmental) associations of various forms are created by citizens for the implementation of initiatives of a non-commercial nature and aimed both at self-realization and at achieving social changes that are significant for society as a whole. It is a resource of the public and public initiative, by which we understand not only the organizational and legal form (public organizations, social movements, etc.), but also those groups, including professional ones, that ensure the performance of socially significant functions.

In Kazakhstan, the need to enhance the role of civil society institutions, in particular the non-governmental sector, as one of the main instruments of market-democratic transformation, contributing to the state policy of modernization, socio-political structuring of society, the formation and implementation of diverse interests of citizens' groups, self-organization of the population, The creation of an infrastructure of stable and effective democracy was only recently recognized.

Today, the state provides substantial support to NGOs, and it has come to this through understanding the role of non-governmental organizations in democratic processes. As the President of the country noted in his Address to the people of Kazakhstan, "non-governmental organizations already play a huge role in Kazakhstan both in human rights activities and in the social stabilization of society. Serious state support is needed, in particular, through a system of grants for the implementation of socially significant projects. It's time to start a large-scale work in this respect as well ".

Active state support for the development of civil society institutions is manifested in the development and adoption of an appropriate regulatory and legal framework and the introduction into practice of the system of privileges and the placement of state social orders among the country's non-governmental organizations.

Legislative support of the activities of non-governmental organizations is the most important condition for their development. Today, the activities of NGOs are regulated by a number of legislative acts.

A number of normative legal acts aimed at supporting NGOs have been adopted:

- Resolution of the Government of the Republic of Kazakhstan "On approval of rates of fees for state registration of legal entities", which mitigates the conditions for registration of certain categories of NGOs;

- Government Decision "On the rules for exemption from value added tax of goods imported to the Republic of Kazakhstan", exempting goods from the tax, imported for charitable purposes through the state, international organizations, which had a favorable effect on the functioning of the public sector;

- The Code of the Republic of Kazakhstan "On Taxes and Other Obligatory Payments", which provides for tax benefits for non-profit organizations;

- Government Decision "On approval of the list of international and state organizations, foreign non-governmental organizations and grants".

Also implemented were:

The concept of state support of non-governmental organizations of the Republic of Kazakhstan, which determined the key positions of the state in relation to the non-governmental sector;

The program of state support of non-governmental organizations of the Republic of Kazakhstan, which created conditions for the sustainable development of NGOs in Kazakhstan, strengthened their role in solving socially significant problems of society on the basis of interaction and support from the state authorities.

Kazakhstan has gained considerable experience in the formation and development of the non-governmental sector since its independence. Among them, the fruitful work of the "third sector", with more than 5.8 thousand NGOs, created the legislative base for the activities of non-governmental organizations, established an effective mechanism for interaction between NGOs and state bodies,. There is also a noticeable increase in the role of NGOs

in society; there is a process of some consolidation of public organizations, an example of which is the Confederation of non-governmental organizations of Kazakhstan, the Civil Alliance of Kazakhstan. At the same time, the role of non-governmental organizations as intermediaries between the authorities in the person of state bodies and society, which solve specific problems in the social sphere.

However, there are a number of difficulties in the development of the Kazakh non-governmental sector, today there are more than 5.8 thousand NGOs in Kazakhstan, however, no more than 20% of organizations actually function, having the necessary material and technical base, achieving significant results in solving social problems of the population. A certain category of non-governmental organizations considers financing and support from the state obligatory, which speaks first of all of the paternalistic approach of representatives of the "third sector", as well as the insufficient maturity for real participation in the process of making political decisions concerning the social problems of the population. The shortage of qualified specialists, working on an ongoing basis, is affected, in most cases, the work of public organizations occurs in certain periods, "from competition to competition," and employees are also recruited for the season, respectively. A certain part of the NGO works primarily on the image of the head of the organization, and the activities of NGOs are aimed more at participating in the political life of the country. In the regional context, specific features of the development of NGOs are visible, the most active NGOs in the city. Astana and Almaty, as well as in industrial regions of the country, including Karaganda, East Kazakhstan and South Kazakhstan oblasts, poorly developed NGOs in rural areas. The population still does not fully understand the role of the non-governmental sector in the public life of the country, which indicates an insufficient level of political culture. This is due to the lack of tradition in the field of NGO activities, the prevailing culture of interaction between the state and the "third sector". Not all executive bodies take an active part in the development of the "third sector" within the framework of the Civil Society Development Concept; support and effective work of state bodies at all levels, central, regional and local.

Kazakhstan needs to further improve the mechanism of interaction between the government and the non-governmental sector, involving the business community, and to increase the level of public awareness in the sphere of the activities of public organizations, this should lead to a qualitative development of NGOs in our country.

International organizations make it possible to unite the environmental activities of the interested states regardless of their political positions, highlighting environmental problems from the totality of all international problems.

The RK actively participates in the work of many international environmental organizations.

The UN is making a great contribution to solving environmental problems. In environmental activities, all its main bodies and specialized agencies participate.

UNEP (UNEP) has been implemented since 1972 and is the main subsidiary body of the United Nations. Through the Economic and Social Council, UNEP submits annual reports on its activities to the UN General Assembly.

UNESCO (from the United Nations Educational, Scientific and Cultural Organization - United Nations Educational, Scientific and Cultural Organization) has existed since 1946 to promote peace and international security, cooperation among States in the field of education, science and culture. The most famous area in the activity is the scientific program "Man and the Biosphere" (MAE), adopted in 1970.

FAO (from the FAO - Food and Agricultural Organization), established in 1945, deals with the issues of food resources and the development of agriculture in order to improve the living conditions of the peoples of the world.

WHO (World Health Organization), established in 1946, has as its main objective the concern for human health, which is directly related to the protection of the Environment.

WMO (World Meteorological Organization) - established as a specialized UN agency in 1951, whose environmental functions are primarily related to global environmental monitoring, including: assessment of transboundary transport of pollutants; the study of the impact on the ozone layer of the Earth.

The ILO (International Labor Organization) is a specialized agency of the United Nations. Created in 1919 under the League of Nations with the goal of creating safe working conditions and reducing the pollution of the biosphere, which often arises from neglect of the working environment.

IAEA (International Atomic Energy Agency) was established in 1957. It carries out its activities under a treaty with the UN, but is not its specialized agency.

Greenpeace - an independent international public organization that aims to prevent environmental degradation, was established in Canada in 1971. It has

about 1.5 million members, 1/3 of whom are Americans. Greenpeace has the status of a full member or official observer in a number of international conventions for the protection of the environment.

Most international non-governmental organizations deal with the protection of individual natural objects or types of natural resources. These include the International Council for the Protection of Birds, the International Federation for the Protection of Alpine Areas, the European Federation for the Protection of Water, etc.

15.2. Preservation of peace and international security

Saving succeeding generations from the scourge of war was the main motivation for creating the United Nations, whose founders lived through the devastation of two world wars. Since its creation, the UN has often been called upon to prevent disputes from escalating into war, or to help restore peace when armed conflict does break out, and to promote lasting peace in societies emerging from wars.

Security Council

Over the decades, the UN has helped to end numerous conflicts, often through actions of the Security Council — the organ with primary responsibility, under the United Nations Charter, for the maintenance of international peace and security. When a complaint concerning a threat to peace is brought before it, the Council's first action is usually to recommend to the parties to try to reach agreement by peaceful means. In some cases, the Council itself undertakes investigation and mediation. It may appoint special representatives or request the Secretary-General to do so or to use his good offices. It may set forth principles for a peaceful settlement.

When a dispute leads to fighting, the Council's first concern is to bring it to an end as soon as possible. On many occasions, the Council has issued ceasefire directives which have been instrumental in preventing wider hostilities. It also deploys United Nations peacekeeping operations to help reduce tensions in troubled areas, keep opposing forces apart and create conditions for sustainable peace after settlements have been reached. The Council may decide on enforcement measures, economic sanctions (such as trade embargoes) or collective military action.

General Assembly

According to the Charter, the General Assembly can make recommendations on the general principles of cooperation for maintaining international peace and security, including disarmament, and for the peaceful settlement of any situation that might impair friendly relations among nations.

The General Assembly can also discuss any question relating to international peace and security and make recommendations, if the issue is not currently being discussed by the Security Council.

Pursuant to its "Uniting for Peace" resolution of November 1950 (resolution 377 (V), the General Assembly may also take action if the Security Council fails to act, owing to the negative vote of a Permanent Member, in a case where there appears to be a threat to or breach of the peace, or act of aggression. The Assembly can consider the matter immediately with a view to making recommendations to Members for collective measures to maintain or restore international peace and security.

Secretary-General

The Charter empowers the Secretary-General to "bring to the attention of the Security Council any matter which in his opinion may threaten the maintenance of international peace and security". One of the most vital roles played by the Secretary-General is the use of his "good offices" – steps taken publicly and in private that draw upon his independence, impartiality and integrity to prevent international disputes from arising, escalating or spreading.

Conflict Prevention

The main strategies for preventing disputes from escalating into conflict, and for preventing the recurrence of conflict, are preventive diplomacy and preventive disarmament. Preventive diplomacy refers to action taken to prevent disputes from arising or from escalating into conflicts, and to limit the spread of conflicts when they occur. It may take the form of mediation, conciliation or negotiation.

Preventive diplomacy

Early warning is an essential component of prevention, and the United Nations carefully monitors developments around the world to detect threats to international peace and security, thereby enabling the Security Council and the Secretary-General to carry out preventive action. Envoys and special representatives of the Secretary-General are engaged in mediation and preventive diplomacy throughout the world. In some trouble spots, the mere presence of a skilled envoy can prevent the escalation of tension. This work is often undertaken in cooperation with regional organizations.

Preventive disarmament

Complementing preventive diplomacy is preventive disarmament, which seeks to reduce the number of small arms in conflict-prone regions. In El Salvador, Liberia, Sierra Leone, Timor-Leste and elsewhere, this has entailed demobilizing combat forces, as well as collecting and destroying their weapons

as part of an overall peace agreement. Destroying yesterday's weapons prevents their being used in tomorrow's wars.

Preventing Genocide and Responsibility to Protect

Prevention requires apportioning responsibility to and promoting collaboration between concerned States and the international community. The duty to prevent and halt genocide and mass atrocities lies first and foremost with the State, but the international community has a role that cannot be blocked by the invocation of sovereignty. Sovereignty no longer exclusively protects States from foreign interference; it is a charge of responsibility where States are accountable for the welfare of their people. This principle is enshrined in article 1 of the Genocide Convention and embodied in the principle of "sovereignty as responsibility" and in the concept of the Responsibility to Protect.

The Special Adviser on the Prevention of Genocide acts as a catalyst to raise awareness of the causes and dynamics of genocide, to alert relevant actors where there is a risk of genocide, and to advocate and mobilize for appropriate action. The Special Adviser on the Responsibility to Protect leads the conceptual, political, institutional and operational development of the Responsibility to Protect. The efforts of their Office include alerting relevant actors to the risk of genocide, war crimes, ethnic cleansing and crimes against humanity, enhancing the capacity of the United Nations to prevent these crimes, including their incitement.

Peacekeeping

United Nations peacekeeping operations are a vital instrument employed by the international community to advance peace and security.

The first UN peacekeeping mission was established in 1948, when the Security Council authorized the deployment of the United Nations Truce Supervision Organization (UNTSO) to the Middle East to monitor the Armistice Agreement between Israel and its Arab neighbours. Since then, there have been a total of 69 UN peacekeeping operations around the world.

Over the years, UN peacekeeping has evolved to meet the demands of different conflicts and a changing political landscape. Born at the time when the Cold War rivalries frequently paralyzed the Security Council, UN peacekeeping goals were primarily limited to maintaining ceasefires and stabilizing situations on the ground, so that efforts could be made at the political level to resolve the conflict by peaceful means.

UN peacemaking expanded in the 1990s, as the end of the Cold War created new opportunities to end civil wars through negotiated peace

settlements. A large number of conflicts were brought to an end, either through direct UN mediation or by the efforts of others acting with UN support. Countries assisted included El Salvador, Guatemala, Namibia, Cambodia, Mozambique, Tajikistan, Sierra Leone, and Burundi. As the decade drew to a close, continuing crises led to new operations in the Democratic Republic of the Congo, the Central African Republic, Timor Leste, Sierra Leone and Kosovo.

In the new millennium, peackeepers have been deployed to Liberia, Côte d'Ivoire, Darfur, South Sudan, Haiti, and Mali.

The conflicts of today, while fewer in number, are deeply rooted. For example, the Democratic Republic of Congo, Darfur, and South Sudan today, are in a second or third wave of conflict. And many are complicated by regional dimensions that are key to their solution. In fact, some two-thirds of peacekeeping personnel today are deployed in the midst of ongoing conflict, where peace agreements are shaky or absent. Conflicts today are also increasingly intensive, involving determined armed groups with access to sophisticated armaments and techniques.

The nature of conflict has also changed over the years. Originally developed as a means of dealing with inter-State conflict, UN peacekeeping has been increasingly applied to intra-State conflicts and civil wars. Although the military remain the backbone of most peacekeeping operations, today's peacekeepers undertake a wide variety of complex tasks, from helping to build sustainable institutions of governance, through human rights monitoring and security sector reform, to the disarmament, demobilization and reintegration of former combatants, and demining.

Peacebuilding

Within the United Nations, peacebuilding refers to efforts to assist countries and regions in their transitions from war to peace and to reduce a country's risk of lapsing or relapsing into conflict by strengthening national capacities for conflict management, and laying the foundations for sustainable peace and development.

Building lasting peace in war-torn societies is among the most daunting of challenges for global peace and security. Peacebuilding requires sustained international support for national efforts across the broadest range of activities – monitoring ceasefires; demobilizing and reintegrating combatants; assisting the return of refugees and displaced persons; helping organize and monitor elections of a new government; supporting justice and security sector reform; enhancing human rights protections and fostering reconciliation after past atrocities.

Peace building involves action by a wide array of organizations of the UN system, including the World Bank, regional economic commissions, NGOs and local citizens' groups. Peace building has played a prominent role in UN operations in Bosnia and Herzegovina, Cambodia, El Salvador, Guatemala, Kosovo, Liberia and Mozambique, as well as more recently in Afghanistan, Burundi, Iraq, Sierra Leone and Timor-Leste. An example of inter-state peace building has been the UN Mission in Ethiopia and Eritrea.

Recognizing that the United Nations needs to better anticipate and respond to the challenges of peacebuilding, the 2005 World Summit approved the creation of a new Peacebuilding Commission. In the resolutions establishing the Peacebuilding Commission, resolution 60/180 and resolution 1645 (2005), the United Nations General Assembly and the Security Council mandated it to bring together all relevant actors to advise on the proposed integrated strategies for post conflict peacebuilding and recovery; to marshal resources and help ensure predictable financing for these activities; and to develop best practices in collaboration with political, security, humanitarian and development actors.

The resolutions also identify the need for the Commission to extend the period of international attention on post-conflict countries and where necessary, highlight any gaps which threaten to undermine peacebuilding.

The General Assembly and Security Council resolutions establishing the Peacebuilding Commission also provided for the establishment of a Peacebuilding Fund and Peacebuilding Support Office.

Demining

In 2014, landmines and explosive hazards killed approximately 10 people every day — most of them children, women and the elderly — and severely maim countless more. Scattered in some 57 countries and 4 territories, landmines and other explosive hazards are an ongoing reminder of conflicts which have been over for years or even decades.

The vision of the United Nations is a world free of the threat of landmines and explosive remnants of war, where individuals and communities live in a safe environment conducive to development and where the needs of victims are met. Twelve United Nations Departments and Offices of the Secretariat, specialized agencies, funds and programmes play a role in mine-action programs in 30 countries and three territories.

Mine action makes it possible for peacekeepers to carry out patrols, for humanitarian agencies to deliver assistance, and for ordinary citizens to live without the fear that a single misstep could cost them their lives.

Mine action entails more than removing landmines from the ground. It includes high impact efforts aimed at protecting people from danger, helping victims become self-sufficient and active members of their communities and providing opportunities for stability and sustainable development.

A policy developed jointly by these institutions, the Mine Action and Effective Coordination: the United Nations Inter-Agency Policy guides the division of labor within the United Nations. Much of the actual work, such as demining and mine-risk education, is carried out by nongovernmental organizations. But commercial contractors and, in some situations, militaries, also provide humanitarian mine-action services. In addition, a variety of intergovernmental, international and regional organizations, as well as international financial institutions, also support mine action by funding operations or providing services to individuals and communities affected by landmines and explosive remnants of war. United Nations peacekeeping operations often play a key role in this process.

The mine-related activities of the UN system are coordinated by the UN Mine Action Service. UNMAS ensures an effective, proactive and coordinated response to the problems of landmines and explosive remnants of war, including cluster munitions. It assesses and monitors the threat posed by mines and unexploded ordnance on an ongoing basis, and develops policies and standards. The Service mobilizes resources, and advocates in support of the global ban on anti-personnel landmines. UNMAS sets up and manages mine-action coordination centres in countries and territories as part of peacekeeping operations and humanitarian emergencies or crises. More recently, UNMAS efforts have further strengthened the mine action response to the threat posed by improvised explosive devices, or IEDs.

The UN has been actively engaged in addressing the problems posed by landmines since the 1980s. It acted decisively to address the use of weapons having indiscriminate effects when it sponsored the 1980 Convention on Certain Conventional Weapons.. In 1996, that Convention was strengthened to include the use of landmines in internal conflicts and to require that all mines be detectable.

Eventually, a growing public outcry, combined with the committed action of non-governmental organizations involved in the International Campaign to Ban Land Mines (ICBL), led to the adoption of a comprehensive global agreement.

The landmark 1997 UN Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-personnel Mines and on Their

Destruction (Mine-Ban Convention) bans the production, use and export of these weapons and has nearly universal support. As of November 2016, it had 162 States parties.

A United Nations International Day for Mine Awareness and Assistance in Mine Action is observed every year on 4 April.

On 14 April 2015, the UN Secretary-General Ban Ki-moon designated the renowned actor Daniel Craig as the first UN Global Advocate for the Elimination of Mines and Explosive Hazards at the UN Headquarters in New York.

Women and Children in Conflict

In contemporary conflicts, as much as 90 percent of casualties are among civilians, most of whom are women and children. Women in war-torn societies can face specific and devastating forms of sexual violence, which are sometimes deployed systematically to achieve military or political objectives. Moreover, women continue to be poorly represented in formal peace processes, although they contribute in many informal ways to conflict resolution.

However, the UN Security Council has recognized that including women and gender perspectives in decision-making can strengthen prospects for sustainable peace. This recognition was formalized in October 2000 with the unanimous adoption of resolution 1325 on women, peace and security. The landmark resolution specifically addresses the situation of women in armed conflict and calls for their participation at all levels of decision-making on conflict resolution and peacebuilding.

Since the agenda was set with the core principles of resolution 1325, three supporting resolutions have been adopted by the Security Council - 1820, 1888 and 1889. The four resolutions focus on two key goals: strengthening women's participation in decision-making and ending sexual violence and impunity.

Since 1999, the systematic engagement of the UN Security Council has firmly placed the situation of children affected by armed conflict as an issue affecting peace and security. The Security Council has created a strong framework and provided the Secretary-General with tools to respond to violations against children.The Special Representative of the Secretary-General for Children and Armed Conflict serves as the leading UN advocate for the protection and well-being of children affected by armed conflict.

Peaceful uses of outer space

The United Nations works to ensure that outer space is used for peaceful purposes and that the benefits from space activities are shared by all nations. This concern with the peaceful uses of outer space began soon after the launch

of Sputnik— the first artificial satellite—by the Soviet Union in 1957, and has kept pace with advances in space technology. The United Nations has played an important role by developing international space law and by promoting international cooperation in space science and technology.

The Vienna-based United Nations Office for Outer Space serves as the secretariat for the Committee on the Peaceful Uses of Outer Space and its subcommittees, and assists developing countries in using space technology for development.

15.3. International eco-policy of the Republic of Kazakhstan

In the second half of the 20th century, mankind entered a new, extremely dangerous phase of its development. Most of the modern researchers come to this conclusion. Such thoughts come to the fore in the programs of political parties, international forums and organizations. In connection with the growing tension of the environmental situation, many countries have begun targeted, comprehensive measures to address environmental problems.

Virtually all states of the world recognize the need for theoretical development and practical steps in the formation of a special, environmental, state activity that provides for the preservation of nature and the environment, the rational use of existing and potential energy sources, etc.

The formation and present state of environmental policy must be analyzed taking into account the general and particular in the cultural, historical, economic and political development of each country. To this or that state of nature protection regulation each state has come by way of a long and peculiar evolution. However, in general, there are two main levels in environmental policy:

1. natural factor / nature protection, human environment, maintenance of ecological balance and its natural state;

2. Factor of social activity / mechanisms of state management of social and ecological relations, processes and methods of legal regulation, budgetary and financial levers.

The World Conservation Strategy adopted by the United Nations in 1982 recommends that the following environmental policies should be considered as main ones: supporting the sustainability of critical ecological processes, preserving genetic diversity in each country, ensuring long-term optimal use of species and ecosystems.

From 3 to 14 June 1992 in Rio de Janeiro (Brazil), a major international conference on environmental issues was held. The conference noted the impossibility of the movement of developing countries along the path that the

developed countries had come to their well-being. This way was recognized as leading to disaster.

The conference discussed topical issues: the nature of production and consumption in the industrialized part of the world, which undermines ecological systems; high population growth; increasingly deepening inequality between rich and poor; An economic system that views unlimited growth as progress. Rio de Janeiro adopted the Agenda for the 21st Century and formulated a concept for the sustainable development of mankind as an alternative to a catastrophe. In one recent definition, sustainable development is understood as "improving the quality of life within the capabilities of surrounding ecosystems".

Kazakhstan participated in the conference and adoption of its main documents: the Rio Declaration and the Program of Action on the Transition of the World Community to Sustainable Development - "Agenda for the 21st Century".

The delegation of the Republic of Kazakhstan, headed by the President of the Republic N.A. Nazarbayev, participated in the work of the Special Session of the UN General Assembly, Rio + 5 (1997), which gave the first global assessment of progress on the implementation of Agenda 21.

From August 26 to September 4, 2002, the World Summit on Sustainable Development (WSSD) took place in Johannesburg. The results of the activities of the international community over the past ten years on the implementation of the Agenda for the 21st Century adopted in Rio de Janeiro were discussed. The results of the WSSD included the Political Declaration of the Summit and the Plan for the Implementation of WSSD Decisions with specific commitments and timeframes, as well as implementation mechanisms, including the use of globalization processes, better resource management, public participation, institutional development and other.

Another form of international cooperation is the creation and operation of intergovernmental specialized organizations at the UN. The United Nations (1945) at its sessions and specialized committees repeatedly addressed the discussion of the problem of nature conservation.

The resolution of the UN General Assembly (1962) "Economic development and nature protection" largely determined the policy of the UN and its specialized departments in the field of environmental protection.

The special structure of the United Nations, the United Nations Environment Program (UNEP), established by the Stockholm Conference (1972), deals with the most acute problems of the ecological crisis

(desertification of land, soil degradation, deforestation, reduction of freshwater resources, pollution of the ocean, reduction of biological diversity). One of the initiatives of UNEP is the creation of a worldwide system for monitoring (monitoring) the state and changes in the biosphere.

Environmental problems like the Aral Sea disaster, loss of biological diversity, reduction and decline in the quality of drinking water supplies and desertification have become much more acute and are now having a devastating impact on the population and on the state of the environment. In this regard, the implementation in the Republic of Kazakhstan of effective measures for the protection and rational use of the environment has become an urgent necessity.

The transition to environmentally sound and sustainable development is now becoming one of the priority areas of Kazakhstan's development strategy. Entering a new century, the Republic of Kazakhstan, like most states, has faced serious environmental problems, and now their decision has been elevated to the level of state policy. In "Strategy-2030" of the Republic of Kazakhstan "improvement of nutrition, cleanliness of the environment and ecology" is one of the priority areas [2].

In 1997, the laws "On Environmental Protection", "On Specially Protected Natural Territories", "On Environmental Expertise", in 1998 "On Radiation Safety", in 2002 "Law on the Protection of Atmospheric Air" were adopted. In the field of rational nature management, Presidential decrees having the force of law, On Subsoil and Subsoil Use (1996) and On Oil (1995), in 2003, Forest, Water and Land Codes. The main principles of the environmental legislation of the Republic of Kazakhstan are:

- ensuring sustainable development of the Republic of Kazakhstan;
- ensuring environmental safety;
- ecologically systematic approach in the regulation of environmental relations;
- state regulation in the field of environmental protection and public administration in the use of natural resources;
- mandatory for preventive measures to prevent pollution and damage to the environment in any other form;
- the inevitability of criminal and administrative liability for violation of the environmental legislation of the Republic of Kazakhstan;
- compulsory compensation for damage to the environment;
- pay and permissive order of impact on the environment;

- application of the best environmentally friendly and resource-saving technologies in the use of natural resources and environmental impact;
- interaction, coordination and publicity of the activities of state environmental protection agencies;
- stimulation of nature users to prevent, reduce and eliminate environmental pollution, reduce waste;
- availability of environmental information;
- ensuring national interests in the use of natural resources and environmental impact;
- harmonization of the environmental legislation of the Republic of Kazakhstan with the principles and norms of international law;
- presumption of environmental hazard of the planned economic and other activities and the obligation to assess the impact on the environment and public health in making decisions on its implementation [3].

The legislation contains the basic principles for conducting eco-policy; new means of implementing eco-policy (for example, taxes or charges for pollution); established new environmental institutions.

The Decree of the President of the Republic of Kazakhstan (December 3, 2003) No. 1241 adopted the Concept of Ecological Safety of the Republic of Kazakhstan for 2004-2015. The concept was developed in accordance with the priorities of the Kazakhstan-2030 Strategy "in accordance with the Strategic Development Plan of the Republic of Kazakhstan, until 2010 and taking into account the main provisions of Agenda 21 and the principles of the Rio Declaration on Environment and Development in 1992, as well as the decisions of the World Summit on Sustainable Development in Johannesburg (2002).

The implementation of the provisions of the Concept consists of three stages:

- the first stage (2004-2007) - reduction of the level of environmental pollution and development of an action plan for its stabilization,
- the second stage (2008-2010) - stabilization of environmental quality indicators and improvement of environmental requirements for the use of natural resources,
- the third stage (2011-2015) - improving the quality of the environment and achieving a favorable level of environmentally sustainable development of society.
- Strategic goals and objectives of environmental safety include:

- the introduction of a unified system for monitoring the state of the environment;
- assessment of the quality of the natural environment, ecological zoning and special mapping of the territory of the Republic of Kazakhstan;
- creation of a system of environmental legislation regulating environmental protection and environmental management;
- fulfillment of the system of environmental control and rationing;
- environmental planning, development of environmental programs, schemes for environmental protection and sustainable use of nature;
- development of the system of ecological transformation and education.

The long-term strategy "Ecology and natural resources - 2030" was developed on the basis of the Concept of Sustainable Development and NEAP of the Republic of Kazakhstan. The main purpose and goal of the long-term environmental strategy is the harmonization of interaction between society and the environment, as well as the creation of an environmentally friendly habitat.

To achieve this goal, up to 2030, four priority areas have been chosen: the formation of an environmentally friendly environment, the balanced use of natural resources, the preservation of diversity of flora and fauna, and environmental education. The long-term strategy envisages four stages: 1998-2000; 2001-2010; 2011-2020 and 2021-2030. For each stage, their goals are set, priorities are chosen and tasks to be determined, taking into account the harmonization of national policies with regional and international environmental policies.

In order to improve the legislation, the republic has taken a course towards rapprochement with the legislation of developed countries and the introduction of international standards. The Republic of Kazakhstan signed 19 international conventions and developed national action plans for their implementation.

Aarhus Convention Ratified by the Law of the Republic of Kazakhstan No. 92-II of October 23, 2000. Ratification of the convention is indicative of a high level of democratic transformation in Kazakhstan and openness of the society, on the other - it enables Kazakhstan to participate fully in all mechanisms of the convention and receive technical and consultative support from the European Community.

Kazakhstan acceded to the Vienna Convention, as well as to the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal, September 16, 1987) by the accession laws of 30.10.1997. №177 and №176.

To preserve biodiversity, the Republic of Kazakhstan ratified the Convention on Biodiversity in 1994, developed a national strategy and action plan for the conservation and sustainable use of biological diversity.

In early 2003 Kazakhstan joined the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. Kazakhstan acceded to the Helsinki Convention on the Protection and Use of Transboundary Watercourses and Lakes, which allows formulating unified legal approaches to the problems of rational use and protection of Transboundary Rivers to the Convention on the Conservation of Migratory Species of Wild Animals, done in Bonn on June 23, 1979.

Kazakhstan intends to use purposefully the capabilities of the UN and its system organizations to take concrete measures aimed at mitigating the negative economic and humanitarian consequences of such technogenic and environmental disasters as the drying up of the Aral Sea, radioactive contamination of the Semipalatinsk test site, pollution of sources of drinking water and their overall reduction. In this regard, special attention should be paid to Kazakhstan's active participation in activities related to the implementation of the Millennium Development Goals and the principles of sustainable development.

To successfully and evenly implement the eco-policy, special funds, committees and commissions have been established in the country designed to develop mechanisms for implementing decisions in the field of environmental protection.

In connection with the deterioration of the environmental situation, there was a sharp increase in Kazakhstan's environmental protection activities, which found their concentrated expression in the field of administrative control and in the methods of economic and legal regulation. Specific programs were developed to implement eco-policy in the territory of Kazakhstan. These programs provide a detailed analysis of environmental problems and suggest methods and methods for their solution.

One of the most important is the program of supplying the population with drinking water. In the Address of the President of the Republic of Kazakhstan to the people of Kazakhstan dated January 28, 2011 it says: "The issues of providing high-quality drinking water are the most important task of improving the health of the people, therefore this will be our priority. The work to provide quality drinking water was started 8 years ago, and there are positive results. Access to centralized water supply in rural settlements increased to 41

percent, in cities to 72 percent. The number of people using imported water decreased by 4 times.

The depreciation of water supply networks in cities is 60 percent. On average, the level of access to drinking water by the republic should reach 98 percent by 2020, and the quality of water must meet all established sanitary standards. It is necessary to develop effective incentives for maximum involvement of private capital in the water sector. It is necessary to widely use the potential of groundwater, apply a systematic approach to the construction of new water supply facilities. In 2020, access to central water supply in cities should be 100 percent. And in rural areas - grow up to 80% .

The above information on the environmental policy of the Republic of Kazakhstan indicates that the state is striving to develop a unified environmental strategy and policy.

On the basis of the foregoing, it should be noted that environmental policy has emerged as an independent and serious branch of politics and law. The solution of environmental problems, both locally, nationally and globally, is very relevant.

Thus, environmental problems relate to this type of problem, the resolution of which can not be delayed. Ecopolitics in this situation is a logical and logical consequence of the existing ecological situation in the world, as well as an increase in the level of interest of the individual and society as a whole towards the extension and improvement of the quality of life on Earth. The opening opportunity to ensure a long-term improvement in the state of the environment can achieve a lot. Without peace and stability, there can be no environmentally healthy continent. Similarly, improving the state of the environment by itself can not ensure peace and prosperity in the region. Only a reasonable combination of local, state, regional and international-global ecopolitics covering all spheres of human activity can guarantee the mitigation of the ecological crisis and, at the same time, the preservation of the natural and resource basis for the sustainable development of peoples and states.

Test tasks for self-control:

1. Classical definition of the concept "sustainable development" as "development of providing the needs of the present generation without prejudice to the ability of future generations to meet their needs" It was first formulated in...

a) the report "Limits of Growth"(1975);

b) the report "Our common future"(1987);

c) The Declaration of Rio de Janeiro on environment and development (1992);

d) Declaration on Sustainable Development in Johannesburg (2002).

2. The Kyoto Protocol (1997) in respect of the countries that acceded to it includes an obligation...

a) reduce the production of private cars by 5% until 2025;

b) to abandon the use of chlorinated solvents in industry until 2010;

c) to reduce or stabilize greenhouse gas emissions in relation to the level of 1991;

d) reduce emissions of ozone-depleting substances into the atmosphere by 50% by 2002.

3. International public environmental organization "Greenpeace" doesn't take financial means in principle coming in the form of donations from ...

a) private individual;

b) state structures;

c) political parties;

d) commercial structures.

4. Public charitable organization "World Wildlife Fund" the main objectives of the activity puts...

a) struggle against the construction of nuclear power plants;

b) development of environmental legislation;

c) conservation of biological diversity of the Earth;

d) prevention of climate change.

5. Who, according to the Charter "Earth Charter" can join and participate in the development of this system:

a) only the state is indeed a member of the UN;

b) only non-governmental organizations;

c) any persons who have paid the membership fees;

d)anyone.

6. As part of the corporate social responsibility concept, commercial organizations acknowledge responsibility for the impact of their activities and voluntarily assume the obligation to consider the interests

a) employees;

b) local communities;

c) natural environment;

d) customers and suppliers.

7. The "Clean Development Mechanism" envisaged by the Kyoto Protocol implies

a) the acquisition on the international market by developed countries from developing countries of unused quotas for emissions of appropriate gases into the atmosphere;

b) the implementation by developed countries in the territories of developing countries of projects aimed at reducing emissions of appropriate gases;

c) mechanism for disseminating information on new technologies that ensure the achievement of higher standards of environmental safety;

d) providing countries with subsidies over fulfill their commitments to reduce gas emissions.

8. The term "pollution export" is used for the symbol of the following process:

a) the movement of hazardous wastes from developed to developing countries for the purpose of disposal;

b) the movement of pollutants in water or air through national boundaries;

c) the movement of environmentally hazardous industries from developed to developing countries;

d) purchase of old equipment by the inhabitants of some countries used in other countries.

9. The central element of the concept of sustainable development, according to the Rio Declaration (1992), is

a) preservation of the natural environment;

b) economic growth;

c) development of international relationships;

d) care of a human;

10. The principle of presumption of potential ecological danger of the planned economic and other activity implies

a) that any activity is considered environmentally hazardous;

b) that the safety of any activity must be proven;

c) that the ecological danger of any activity can not be a priority factor when deciding on the implementation of this activity;

d) that perpetrators of environmentally hazardous activities should be held accountable for their acts.

GLOSSARY ECOLOGY

Abundance: The number of organisms in a population, combining "intensity" (density within inhabited areas) and "prevalence" (number and size of inhabited areas)

Adaptation: 1) Characteristics of organisms evolved as a consequence of natural selection; 2) Changes in the form or behavior of an organism during life as a response to environmental stimuli; 3) Changes in the excitability of a sense organ as a result of continuos stimulation.

Biodiversity: (Gk. bios, life) Refers to aspects of variety in the living world; used to describe the number of species, the amount of genetic variation or the number of community types present in the area.

Biogeochemical Cycle: The movement of chemical elements between organisms and non-living compartments of the atmosphere, lithosphere and hydrosphere. Biogeography: The study of the geographical distribution of organisms; it largely depends on abiotic factors, resources, community interaction, mobility of organisms (whether large or small), topography, geohistorical factors (continental drift, island formation, etc.) e.g. small island hosts fewer species, fewer resources, fewer habitats than a larger one; the species on an island are balanced by the death- and immigration rate of organisms but is less stable compared to a larger island or even continent - applies for natural reserves as well (see ecology pattern and disturbance - space).

Biomagnification: The increasing concentration of a compound in the tissues of organisms as the compound passes along a food chain, resulting from the accumulation of the compound at each trophic level prior to its consumption by organisms at the next trophic level, as seen with DDT

Biome: Large, ecological unit composed of similar types of climax communities on a global scale, arising as a result of complex interactions of climate, other physical factors, and biotic factors (e.g., rainforest, tundra, grassland....)

Biosphere: The zone of air, land and water at the surface of the earth that is occupied by organisms.

Biotic: Living; usually applied to the biolog

Climate: The accumulation of seasonal weather patterns in an area over a long period of time

Community: The species that occur together in space and time; (see diversity and isotherms)

Competitive Exclusion Principle: Two species with similar environmental requirements cannot coexist indefinitely in the same habitat. (see Gausse's principle.)

Consumer: An organism within an ecosystem, plant or animal, that derives its food from another organism (see predator).

Decomposer: Organisms (bacteria, fungi, heterotrophic protists) in ecosystems that break down complex organic material into smaller inorganic molecules that then are recirculated. Denitrification: The conversion of nitrate to gaseous nitrogen; carried out by a few genera of free-living soil bacteria

Density: In relation to population, the number of individuals in a certain amount of space.

Ecology: The study of the interactions of organisms with their physical environment (abiotic) and with one another (biotic).

Ecosystem: All of the organisms of a given area and the encompassing physical environment.

Endemic: Having their habitat in a specified district or area, or the presence of a disease at relatively low level, all the time.

Environment: The combination of all the external conditions and the potential effect of the inner environment (heteromosaic of abiotic conditions).

Eutrophication: Enrichment of a water body with plant nutrients (P and N), usually resulting in a community dominated by phytoplankton (see cycle - P, N).

Eutrophic: An aquatic environment with high nutrient levels, characterized by dense blooms of algae and other aquatic plants.

Evolution: (L. evolvere, to evolve) Changes in gene frequencies in a population over time

Extrinsic Factors: Literally, factors acting from outside. In ecology, physical and chemical features of the environment, and other organisms, are all extrinsic factors acting on an organism (see density factors).

Food: Organic compounds used in the synthesis of new biomolecules and as fuel in the production of cellular energy; i.e. carbohydrates (glucose), starch (amylose, amylopectic), proteins (from aminoacids), fatty acids, vitamins, trace elements

Gausse Law: The idea that if two competing species coexist in a stable environment, then they do so as a result of differentiation of their realized niches; but if there is no such differentiation, or if it is precluded by the habitat, then one competing species will eliminate or exclude the othe

Habitat: (L. habitare, to inhabit) The environment of an organism; the place where it is usually found.

Intrinsic Factors: Factors acting from within, e.g. intraspecific competition, etc. (see density factors).

Island Biogeography Theory: Is in the application on nature conservation. This is because many conserved areas and nature reserves are surrounded by an 'ocean' of habitat made unsuitable, and therefore hostile, by humans

Migration: The movement of individuals, and commonly whole populations from one region to another.

Nitrification: The oxidation of ammonium ions or ammonia to nitrate; a process carries out by a specific freeliving soil bacterium.

Organic: Pertaining to living organisms in general, to compounds formed by living organisms, and to the chemistry of compounds containing carbon.

Organism (individual): Any individual living creature, either unicellular or multicellular:

Physiological Time: A measure combining time and temperature and applied to ectothermic (poikilothermic) organisms, reflecting the fact that growth and development in particular are dependent on environmental temperature and therefore require a period of time-temperature rather than simply time for their completion.

Population: Any group of individuals, usually of a single species, occupying a given area at the same time; groups of organisms with homologue (same) alleles.

Resource : That which may be consumed by an organism and, as a result, becomes unavailable to another, e.g. food, water, nesting sites, CO2, minerals solar energy,etc. R. for autotrophs: light, water, minerals, CO2, O2 (at night) space, etc. R. for heterotrophs: Consists basically in the food chain provided (see there)

Transpiration: The loss of water from plants by evaporation, mainly through the stomata on stems and leaves.

Trophic Level: (Gk. trophos, feeder) A step in the movement of energy through an ecosystem, represented by a particular set of organisms (see biomass).

Autotrophic: An organism that is independent of outside sources for organic food materials and manufactures its own organic material from inorganic sources.

Heterotrophic: An organism with a requirement for energy-rich organic molecules from outside (animals, fungi and most bacteria).

Vorous: (L. voreare, to devour) Eating or feeding on.

Carniv.: (L. carnum, meat) An animal that eats the flesh of other animals.

Detriv.: (L. detritus, decay) An organism that takes energy from dead or waste organic matter. Herbiv.: (L. herbum, plant) An animal that consumes plants as food. Omniv.: (L. omni, all) An animal that consumes both plant and animal matter as food.

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