

Topic #9

The biosphere and the place of man in it

Motivation

The biosphere (Greek bios - life, sphaira - ball, sphere) is the complex outer shell of the Earth, inhabited by organisms that together 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 surrounding humans. Man, like other living beings, is directly dependent on the surrounding nature. But unlike them, people actively influence the biosphere through labor activity, the scale of which is steadily increasing. Man's mastery of various types of energy (mechanical, electrical, nuclear), and the development of new technologies of agricultural and industrial production contribute to a significant transformation of the biosphere. In the early stages of human existence, his activities did not upset the balance in the biosphere. As the number of people increased and civilization developed, the intensity of our society's use of natural resources began to increase sharply. Man becomes a powerful environmental factor that disrupts the balance in the biosphere.

The pace of socio-economic development of humanity over time is increasingly faster than the pace of natural evolutionary development, and the scale of human impact on nature has begun to exceed all known geological processes. Unwisely expanding the boundaries of his ecological niche, which he occupied in the biosphere as its natural element, man, in the process of productive activity, increasingly changed other parameters of the biosphere. As a result, in the modern period, the established rates of natural biochemical cycles in the biosphere are disrupted, the climate is changing, the structure and composition of the gene pool is deteriorating, the thickness of the ozone layer is decreasing, etc.

Large-scale anthropogenic activity not only disrupts the development of biosphere processes, but also alienates humanity from nature. It is no longer in organic unity, either with biotopes or with biocenoses as a whole. Most often, a person acts as an external factor in relation to the latter, while trying to subordinate nature to his interests. Most of its activities go beyond the boundaries of ecosystem

laws and sometimes develop in spite of them. Ultimately, these global changes may prove fatal for humans, and they may lose their place in the biosphere. For the first time in many millennia, man entered into a major conflict with the biosphere.

The purpose of the practical lesson: to familiarize students with the concept of the biosphere, its structure, properties (according to V.I. Vernadsky). Form an idea of the place of man in the biosphere.

Questions for oral questioning

1. Biosphere, concept, composition, boundaries.
2. Properties of the biosphere according to V.I. Vernadsky.
3. Classification of natural ecosystems of the biosphere.
4. The main types of anthropogenic impacts on the biosphere (atmospheric air, hydrosphere, lithosphere, on biotic communities).
5. Special and extreme impacts on the biosphere.

List of knowledge and practical skills

After mastering the topic, the student must know the general laws of ecology

After mastering the topic, the student must be able to carry out the prevention of environmentally-related diseases among the population, carry out awareness-raising and health education work on environmental education and training.

Independent work of students at classes:

1. Hearing and discussion of an essay prepared according to the individual instructions of the teacher.
2. Completing a test task on the topic of the lesson.

Reference material

Biosphere - in the modern understanding is considered as global ecosystem (ecosphere). Like any ecosystem, the biosphere consists of an abiotic and biotic part. *The abiotic part* is represented by: 1) *soil and underlying rocks* to the depth where they still contain living organisms that enter into exchange with the substance of these rocks and the physical environment of the pore space; 2) *atmospheric air* to heights at which manifestations of life are still possible; 3) *the aquatic environment* of oceans, rivers, lakes, etc. *The biotic part* consists of living organisms of all taxa that perform the most important function of the biosphere, without which life itself cannot exist: *the biogenic flow of atoms*. Living organisms carry out this flow of atoms through their respiration, nutrition and reproduction, ensuring the exchange of matter between all parts of the biosphere

The doctrine of V. I. Vernadsky about the biosphere

According to modern concepts, **the biosphere** is a special shell of the Earth that contains the entire totality of living organisms and that part of the planet's substance that is in continuous exchange with these organisms. These ideas are based on the teachings of V.I. Vernadsky (1863–1945) about the biosphere, which is the largest generalization in the field of natural science in the 20th century. The exceptional significance of his teachings became fully apparent only in the second half of the last century. This was facilitated by the development of ecology, and above all global ecology, where the biosphere is a fundamental concept. The doctrine of V. I. Vernadsky about the biosphere is an integral fundamental teaching, organically connected with the most important problems of the preservation and development of life on Earth, marking a fundamentally new approach to the study of the planet as a developing self-regulating system in the past, present and future.

According to the ideas of V.I. Vernadsky, the biosphere includes *living matter* (i.e., all living organisms), *biogenic* (coal, limestone, oil, etc.), *inert* (living matter does not participate in its formation, for example, igneous rocks), *bioinert* (created with the help of living organisms), as well as *radioactive* substances, substances *of cosmic*

origin (meteorites, etc.) and *scattering of atoms*. All these seven different types of substances are geologically related.

The essence of V.I. Vernadsky's teaching lies in the recognition of the exceptional role of “living matter” that transforms the appearance of the planet. The total result of his activities over the geological period of time is enormous. According to V.I. Vernadsky, “on the earth's surface there is no chemical force more constantly acting, and therefore more powerful in its final consequences, than living organisms taken as a whole.” It is living organisms that capture and transform the radiant energy of the Sun and create the endless diversity of our world.

The second most important aspect of the teachings of V.I. Vernadsky is the idea he developed about *the organization of the biosphere*, which is manifested in the coordinated interaction of living and nonliving things, the mutual adaptability of the organism and the environment. V.I. Vernadsky also substantiated the most important ideas about the forms of transformation of matter, the paths of biogenic migration of atoms, that is, the migration of chemical elements with the participation of living matter, the accumulation of chemical elements, the driving factors in the development of the biosphere, etc.

The most important part of the doctrine of the biosphere V.I. Vernadsky are ideas about *its emergence and development*. The modern biosphere did not arise immediately, but as a result of long evolution. The highest stage of development of the biosphere is **the noosphere** (“thinking shell”, sphere of the mind). V.I. Vernadsky wrote that this is “the sphere of interaction between nature and society, within which reasonable human activity becomes the main, determining factor of development .” The formation of the noosphere “is not an accidental phenomenon on our planet”, “the creation of a free mind”, “human genius”, but “a natural phenomenon, sharply materially manifested in its consequences in the human environment.” In other words, the noosphere is the environment surrounding humans, in which the natural processes of metabolism and energy are controlled by society. Man, according to V.I. Vernadsky, is part of the biosphere, its “certain function.” Emphasizing the close connection between man and nature, he admitted that the

prerequisites for the emergence of the human mind took place back in the days of animals, the predecessors of Homo sapiens, and its manifestation began millions of years ago, at the end of the Tertiary period. But only man was able to manifest himself as a new geological force.

Our planet has a heterogeneous structure and consists of concentric shells (geospheres) - internal and external. The internal ones include the core, the mantle, and the external ones include **the lithosphere (earth's crust), hydrosphere, atmosphere and the complex shell of the Earth - the biosphere**. The term "biosphere" was first introduced into science by the Austrian geologist E. Suess in 1875. The role and significance of the biosphere for the development of life on our planet turned out to be so great that already in the first third of the 20th century, a new fundamental scientific direction in natural science arose - ***the doctrine of the biosphere***, the founder of which is the great Russian scientist V.I. Vernadsky.

Lithosphere (Greek "cast" - stone) is the rocky shell of the Earth, including the earth's crust with a thickness (thickness) from 6 (under the oceans) to 80 km (mountain systems). *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% are basalts, granites and other igneous rocks, about 17% are rocks transformed by pressure and high temperature, and only a little more than 12% are sedimentary. The earth's crust is the most important resource for humanity. It contains combustible minerals (coal, oil, oil shale), ore (iron, aluminum, copper, tin, etc.) and non-metallic (phosphorites, apatites, etc.) minerals, natural building materials (limestones, sands, gravel and etc.). ***Hydrosphere*** (Greek "hydror" - water) is the watery shell 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 oceans, seas, lakes, rivers, reservoirs, swamps, glaciers, snow covers, etc. All these waters are permanently or temporarily located on the earth's surface and are called surface water. The surface hydrosphere does not form a continuous layer and intermittently covers the earth's surface by 70.8%. *Underground hydrosphere* - includes water located in the upper part of the earth's crust. They are called underground. The underground hydrosphere

is limited from above by the surface of the earth; its lower boundary cannot be traced, since the hydrosphere penetrates very deeply into the thickness of the earth's crust. **Atmosphere** (Greek “atmos” - steam) - the gas shell of the Earth, consisting of a mixture of various gases, water vapor and dust (Table 6.3 according to N. Reimers, 1990). The total mass of the atmosphere is $5.15 \cdot 10^{15}$ 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 that protects the Earth from excessive ultraviolet radiation, which is fatal to organisms. The atmosphere, hydrosphere and lithosphere interact closely with each other. Almost all surface exogenous geological processes are caused by this interaction and usually take place in the biosphere. *The biosphere* is the outer shell of the Earth, which includes part of the atmosphere up to a height of 25–30 km (up to the ozone layer), almost the entire hydrosphere and the upper part of the lithosphere to a depth of approximately 3 km.

Extreme destructive impacts on the natural environment

Extreme destructive impacts on the natural environment can be *anthropogenic* (military actions, accidents, catastrophes) and *natural* (natural disasters). Territories where, as a result of accidents, catastrophes, military operations or natural disasters, negative changes in the environment occur that threaten human health, the state of natural ecological systems, and the genetic fund of plants and animals are declared zones of environmental emergency.

Anthropogenic impacts are understood as activities related to the implementation of economic, military, recreational, cultural and other human interests, introducing physical, chemical, biological and other changes to the natural environment.

Special types of anthropogenic impact on the biosphere include:

- 1) environmental pollution with hazardous waste;
- 2) noise impact;
- 3) biological pollution;

4) exposure to electromagnetic fields and radiation and some other types of exposure.

Noise impact – one of the forms of harmful physical impact on the natural environment. *Noise pollution* occurs as a result of an unacceptable excess of the natural level of sound vibrations. From an environmental point of view, in modern conditions noise becomes not only unpleasant to the ear, but also leads to serious physiological consequences for humans. In urban areas of developed countries, tens of millions of people suffer from noise.

Under *biological contamination* understand the introduction into ecosystems as a result of anthropogenic impact of uncharacteristic species of living organisms (bacteria, viruses, etc.), worsening the conditions of existence of natural biotic communities or negatively affecting human health