KOSTANAY STATE PEDAGOGICAL UNIVERSITY

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A COURSE OF LECTURES ON ECOLOGY AND LIFE SAFETY BASICS

Textbook

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The textbook is recommended for organization of the educational process in conducting lectures on the course "Ecology and life safety basics".

The textbook is intended for students, and can also be useful for a wide range of teachers, educators and specialists in other areas interested in the basics of ecology and life safety.

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CONTENTS

INTRODUCTION

Our survival has depended upon how well we could observe variations in the environment and predict the responses of organisms to those variations. The earliest hunters and gatherers had to know the habits of their animal prey and where to find food plants. Later, agriculturists had to be aware of variations in weather and soils and of how such variation might affect crops and livestock. Today, most of earth's human population live in cities and most of us have little direct contact with nature. More than ever before, though, the future of our species depends on how well we understand the relationships between organisms and the environment. Our species are rapidly changing earth's environment, yet we do not fully understand the consequences of these changes. For instance, human activity has increased the quantity of nitrogen cycling through the biosphere, changed land cover across the globe, and increased the atmospheric concentration of CO_2. Changes such as these threaten the diversity of life on earth and may endanger our life support system.

The changes in the biosphere, which are the result of active human activity in the present century (rising of the Earth's surface temperature, global pollution of water, air and soil, desertification of the planet, pollution of the oceans, destruction of the ozone layer) are now known to everyone. World experience shows that the ecologization of the entire social and economic system of any state is the basis for the successful solution of environmental problems and the prevention of environmental disasters.

Environmental safety, as an integral part of national security, is an indispensable condition for sustainable development and serves as a basis for preserving natural systems and maintaining the appropriate quality of the environment.

The course "Ecology and life safety basics" is aimed at forming students' ecological thinking and examines the main ecological concepts and patterns of the functioning of natural systems, the tasks of ecology as a science, its main sections. It also contains sections in which the topic of safe interaction between a person and his environment (natural, man-made) is combined with issues of protecting a person from negative factors of emergency situations.

The goal of the course: to help to develop knowledge, skills in the field of the regularities of the functioning of natural systems, as well as to study the basic concepts and principles of ensuring human life safety.

The objectives of the course:

1. to familiarise students with the environmental problems of modern civilization;
2. to study the basic laws governing the functioning of living organisms, ecosystems of various organizations of the biosphere as a whole and their stability;
3. to study the basics of healthy lifestyle;

4. to study the diversity of emergency situations of various origins (natural, technogenic, social);
5. to study the foundations of the autonomous survival of man in extreme natural conditions;
6. to study the features of behavior in situations of threat of a terrorist act;
7. to study the features of first aid in different situations;
8. to improve the logical reasoning.

Formed competences

Know:

- the basic laws of interaction between nature and society;
- basics of ecosystem functioning and development of the biosphere;
- the impact of harmful and hazardous factors of production and the environment on human health;
- concept, strategy, sustainable development issues, practical approaches to solving them at the global, regional and local levels;
- the principles of organization of safe production processes;
- organizational framework for security;
- theoretical foundations related to the impact of natural and man-made hazards on the human organism;
- classification and types of emergency situations, the mechanism of their effects on the human organism and the environment, methods and ways of protection.

Be able to:

- assess the ecological state of the environment;
- assess the technogenic impact on the environment;
- create safe living conditions;
- use personal protective equipment;
- if necessary, provide first aid in case of injuries, bleeding, wounds, burns, frostbite, etc.;
- if necessary, provide all possible assistance in disaster management.

Skills:

- determine the components of ecosystems and the biosphere as a whole;
- determine the optimal conditions for sustainable development of ecological systems;
- doing logical discussions on topics related to the solution of environmental problems;
- search and organizing of scientific and specialist literature.

The textbook contains lectures focusing on basic terminology. The material of lectures is accompanied by many examples, figures, tables. It also includes vocabulary and a glossary of terms.

Topic: Introduction to Ecology

Goal: to form knowledge about ecology as a science, its main concepts; to study the diversity of environmental problems, their occurrence, consequences and solutions.

Plan:

1. Ecology
2. Brief history of Ecology
3. Ecology as a multi-disciplinary science
4. Environmental problems

Ecology

What is ecology? Ecology is the study of relationships between organisms and the environment. The word environment refers to everything around us: the air, the water and the land as well as the plants, animals, and microorganisms that inhabit them. The environment of an organism includes both physical properties, which can be described as the sum of local abiotic factors such as solar insolation, climate and geology, as well as the other organisms that share its habitat.

The modern definition of ecology is: the scientific discipline, that is concerned with the relationship between organisms and their past, present and future environments, both living and non-living. Science, of course, represents a body of knowledge about the world and all its parts. It is also a method for finding new information. Thus Ecology, or ecological science, is the scientific study of the distribution and abundance of living organisms and how the distribution and abundance are affected by interactions between the organisms and their environment. Ecologists may study individual organisms, entire forests or lakes, or even the whole earth. The measurements made by ecologists include counts of individual organisms, rates of reproduction, or rates of processes such as photosynthesis and decomposition. Ecologists often spend as much time studying nonbiological components of the environment, such as temperature or soil chemistry, as they spend studying organisms.

Ecologists are interested in where animals and plants live and how they interact with each other. They answer such questions as «What would happen to all the oak trees in a forest if the climate becomes drier?» and «Will there be more greenflies on a tree if the ladybirds are all destroyed by a disease?».

Today many people are worried about «Global Warming». They try to predict what will happen to the world, and its animals and plants, if the average temperature of the world goes up. The relationship between man and nature has become one of the major problems facing civilization today. Ecology, a vital philosophical issue, stands at the crossroads of politics, science and economics.

Brief history of Ecology

The word «ecology» comes from the Greek words (oikos, «house- hold») and (logos, «study»). The word «ecology» is often used as a synonym for the natural environment or environmentalism. Ecology is generally spoken of as a new science, having only become prominent in the second half of the 20th Century. Nonetheless, ecological thinking at some level has been around for a long time, and the principles of ecology have developed gradually, closely intertwined with the development of other biological disciplines.

The Greek philosopher Theophrastus was one of the first people to discuss the relationship between living things and their environments. German zoologist Ernst Haeckel coined the term oikologie, defined as the relationship of an animal to both its organic and inorganic environment, particularly those plants and animals with which it comes in contact.

Until the early 20th century, biologists concentrated on descriptive studies of plants and animals.

Throughout the 18th and the beginning of the 19th century, the great maritime powers such as Britain, Spain, and Portugal launched many world exploratory expeditions to develop maritime commerce with other countries, and to discover new natural resources, as well as to catalog them. At the beginning of the 18th century, about twenty thousand plant species were known, versus forty thousand at the beginning of the 19th century, and almost 400,000 today. These expeditions were joined by many scientists, including botanists, such as the German explorer Alexander von Humboldt. Humboldt is often considered a father of ecology. He was the first to take on the study of the relationship between organisms and their environment. He exposed the existing relationships between observed plant species and climate, and described vegetation zones using latitude and altitude, a discipline now known as geobotany. One of Humboldt's famous works was «Idea for a Plant Geography» (1805).

Towards 1850 there was a breakthrough in the ecology with the publishing of the work of Charles Darwin on The Origin of Species: Ecology passed from a repetitive, mechanical model to a biological, organic, and hence evolutionary model. Alfred Russel Wallace, contemporary and competitor to Darwin, was first to propose a «geography» of animal species. Several authors recognized at the time that species were not independent of each other, and grouped them into plant species, animal species, and later into communities of living beings or biocoenosis. This term was coined in 1877 by Karl Möbius.

By the 19th century, ecology blossomed due to new discoveries in chemistry by Lavoisier and de Saussure, notably the nitrogen cycle. After observing the fact that life developed only within strict limits of each compartment that makes up the atmosphere, hydrosphere, and lithosphere, the Austrian geologist Eduard Suess proposed the term biosphere in 1875.

Suess proposed the name biosphere for the conditions promoting life, such as those found on Earth, which includes flora, fauna, minerals, matter cycles, et cetera. In the 1920s Vladimir Vernadsky, a Russian geologist detailed the idea of the biosphere in his work «The biosphere» (1926), and described the fundamental principles of the biogeochemical cycles. He thus redefined the biosphere as the sum of all ecosystems.

First ecological damages were reported in the 18th century, as the multiplication of colonies caused deforestation. Since the 19th century, with the industrial revolution, more and more pressing concerns have grown about the impact of human activity on the environment. The term ecologist has been in use since the end of the 19th century. Over the 19th century, botanical geography and zoogeography combined to form the basis of biogeography. This science, which deals with habitats of species, seeks to explain the reasons for the presence of certain species in a given location. It was in 1935 that Arthur Tansley, the British ecologist, coined the term ecosystem, the interactive system established between the biocoenosis (the group of living creatures), and their biotope, the environment in which they live. Ecology thus became the science of ecosystems.

By the 1930s, nature study became part of the curriculum of most schools, but organisms were still viewed in isolation rather than as communities.

Tansley's concept of the ecosystem was adopted by the energetic and influential biology educator Eugene Odum. Along with his brother, Howard Odum, Eugene P. Odum wrote a textbook on ecology.

Human development degraded the environment because people did not understand their relationship with it; that we have as much impact on our surroundings as they do on us. By the 1970s ecology, formerly an obscure science became a household word.

Ecology as a multi-disciplinary science

Ecology is usually considered a branch of biology, the general science that studies living organisms. Organisms can be studied at many different levels, from proteins and nucleic acids (in biochemistry and molecular biology), to cells (in cellular biology), to individuals (in botany, zoology, and other similar disciplines), and finally at the level of populations, communities, and ecosystems, to the biosphere as a whole; these latter strata are the primary subjects of ecological inquiries.

Ecology is a multi-disciplinary science. Because of its focus on the higher levels of the organization of life on earth and on the interrelations between organisms and their environment, ecology draws heavily on many other branches of science, especially geology and geography, meteorology, pedology, chemistry, and physics. Thus, ecology is considered by some to be a holistic science, one that over-arches older disciplines such as biology which in this view become sub-disciplines contributing to ecological knowledge.

Ecology is a broad discipline comprised of many sub-disciplines. A common, broad classification, moving from lowest to highest complexity, where complexity is defined as the number of entities and processes in the system under study, is:

Physiological Ecology (or ecophysiology) and Behavioral ecology examine adaptations of the individual to its environment.

Population ecology (or autecology) studies the dynamics of populations of a single species.

Community ecology (or synecology) focuses on the interactions between species within an ecological community.

Ecosystem ecology studies the flows of energy and matter through the biotic and abiotic components of ecosystems.

Landscape ecology examines processes and relationship across multiple ecosystems or very large geographic areas.

Ecology can also be subdivided according to the species of interest into fields such as animal ecology, plant ecology, insect ecology, and so on. Another frequent method of subdivision is by biome studied, e.g., arctic ecology (or polar ecology), tropical ecology, desert ecology, etc.

Environmental science is an interdisciplinary study of connections between the earth's life-support system and human activities (table 1).

Table 1

Major Fields of Study Related to Environmental Science

Major Fields	**Subfields**
Biology: study of living things (organisms)	**Ecology:** study of how organisms interact with one another and with their nonliving environment
	Botany: study of plants
	Zoology: study of animals
Chemistry: study of chemicals and their interactions	**Biochemistry:** study of the chemistry of living things
Earth science: study of the planet as a whole and its nonliving systems	**Climatology:** study of the earth's atmosphere and climate
	Geology: study of the earth's origin, history, surface, and interior processes
	Hydrology: study of the earth's water resources
	Paleontology: study of fossils and ancient life
Social sciences: studies of human society	**Anthropology:** study of human cultures
	Demography: study of the characteristics of human populations

	Geography: study of the relationships between human populations and the earth's surface features
	Economics: study of the production, distribution, and consumption of goods and services
	Political Science: study of the principles, processes, and structure of government and political institutions
Humanities: study of the aspects of the human condition not covered by the physical and social sciences	**History:** study of information and ideas about humanity's past
	Ethics: study of moral values and concepts concerning right and wrong human behavior and responsibilities
	Philosophy: study of knowledge and wisdom about the nature of reality, values, and human conduct

As a scientific discipline, ecology does not dictate what is «right» or «wrong». However, ecological knowledge such as the quantification of biodiversity and population dynamics has provided a scientific basis for expressing the aims of environmentalism and evaluating its goals and policies. Additionally, a holistic view of nature is stressed in both ecology and environmentalism.

Environmental problems

Our planet is home to millions of different species of plant and animal, which are connected in different ways. Together, they make up the complex world of nature. Unfortunately, co-habiting with humans gives ecological problems.

For thousands of years people lived in harmony with environment. They thought to that natural riches were unlimited. However, with the development of civilization man's interference in nature began to increase. Large cities with thousands of smoky industrial enterprises appear all over the world today. The by-products of their activity pollute the air we breathe, the water we drink, the land we grow grain and vegetables.

Why Do We Have Environmental Problems?

As we run more and more of the earth's natural resources through the global economy, in many parts of the world, forests are shrinking, deserts are expanding, soils are eroding, and agricultural lands are deteriorating. In addition, the lower atmosphere is warming, glaciers are melting, sea levels are rising, and storms are becoming more destructive. And in many areas, water tables are falling, rivers are running dry, fisheries are collapsing, coral reefs are disappearing, and various species are becoming extinct. According to a number of environmental and social scientists, the major causes of these and other environmental problems are population growth, wasteful and unsustainable resource use, poverty, failure to include the harmful environmental costs of goods and services in their market prices, and insufficient knowledge of how nature works.

Ecological problem - this change of the natural environment as a result of anthropogenic influences, leading to disruption of the structure and functioning of nature. Problems associated with discernible human influence on nature, the reverse influence of nature on man and his economy.

Pollution is any influence in the environment that is harmful to the health, survival, or activities of humans or other organisms. Pollutants can enter the environment naturally, such as from volcanic eruptions, or through human activities, such as burning coal and gasoline and discharging chemicals into rivers and the ocean. The pollutants we produce come from two types of sources. Point sources are single, identifiable sources. Examples are the smokestack of a coal-burning power or industrial plant, the drainpipe of a factory, and the exhaust pipe of an automobile. Nonpoint sources are dispersed and often difficult to identify. Examples are pesticides blown from the land into the air and the runoff of fertilizers and pesticides from farmlands, lawns, gardens, and golf courses into streams and lakes. It is much easier and cheaper to identify and control or prevent pollution from point sources than from widely dispersed non- point sources. There are two main types of pollutants. Biodegradable pollutants are harmful materials that can be bro-ken down by natural processes. Examples are human sewage and newspapers. Nondegradable pollutants are harmful materials that natural processes cannot break down. Examples are toxic chemical elements such as lead, mercury, and arsenic. Pollutants can have three types of unwanted effects. First, they can disrupt or degrade life-support systems for humans and other species. Second, they can damage wildlife, human health, and property. Third, they can create nuisances such as noise and unpleasant smells, tastes, and sights.

Ozone Layer Depletion. The ozone layer is an invisible layer of protection around the planet that protects us from the sun's harmful rays. Depletion of the crucial Ozone layer of the atmosphere is attributed to pollution caused by Chlorine and Bromide found in chlorofluorocarbons (CFC's). Once these toxic gases reach the upper atmosphere, they cause a hole in the ozone layer, the biggest of which is above the Antarctic.

Climate change is yet another environmental problem that has surfaced in last couple of decades. It occurs due to rise in global warming which occurs due to increase in temperature of atmosphere by burning of fossil fuels and release of harmful gases by industries. Climate change has various harmful effects but not limited to melting of polar ice, change in seasons, occurrence of new diseases, frequent occurrence of floods and change in overall weather scenario.

Global Warming**.** Climate changes like global warming is the result of human practices like emission of Greenhouse gases. Global warming leads to rising temperatures of the oceans and the earth' surface causing melting of polar ice caps, rise in sea levels and also unnatural patterns of precipitation such as flash floods, excessive snow or desertification.

Greenhouse effect. Scientists often use the term "climate change" instead of global warming. This is because as the Earth's average temperature climbs, winds and ocean currents move heat around the globe in ways that can cool some areas, warm others, and change the amount of rain and snow falling. As a result, the climate changes differently in different areas.

The "greenhouse effect" is the warming that happens when certain gases in Earth's atmosphere trap heat. These gases let in light but keep heat from escaping, like the glass walls of a greenhouse.

On Earth, human activities are changing the natural greenhouse. Over the last century the burning of fossil fuels like coal and oil has increased the concentration of atmospheric carbon dioxide (CO_2). This happens because the coal or oil burning process combines carbon with oxygen in the air to make CO_2. To a lesser extent, the clearing of land for agriculture, industry, and other human activities has increased concentrations of greenhouse gases.

Most climate scientists agree the main cause of the current global warming trend is human expansion of the "greenhouse effect" (fig. 1). The greenhouse gases include water vapor, carbon dioxide, methane, ozone, nitrous oxide, and chlorofluorocarbons. Approximately 70% of the solar energy shining on the earth is absorbed either by the atmosphere or by the earth's surface. This energy is reemitted as infrared radiation. Some of the infrared radiation from the atmosphere is radiated into space, and some is radiated toward the surface of the earth. Most of the infrared radiation from the earth's surface is absorbed by greenhouse gases in the atmosphere and radiated back to the earth's surface. By radiating infrared radiation back to the earth's surface, greenhouse gases trap heat energy and raise the earth's surface temperature.

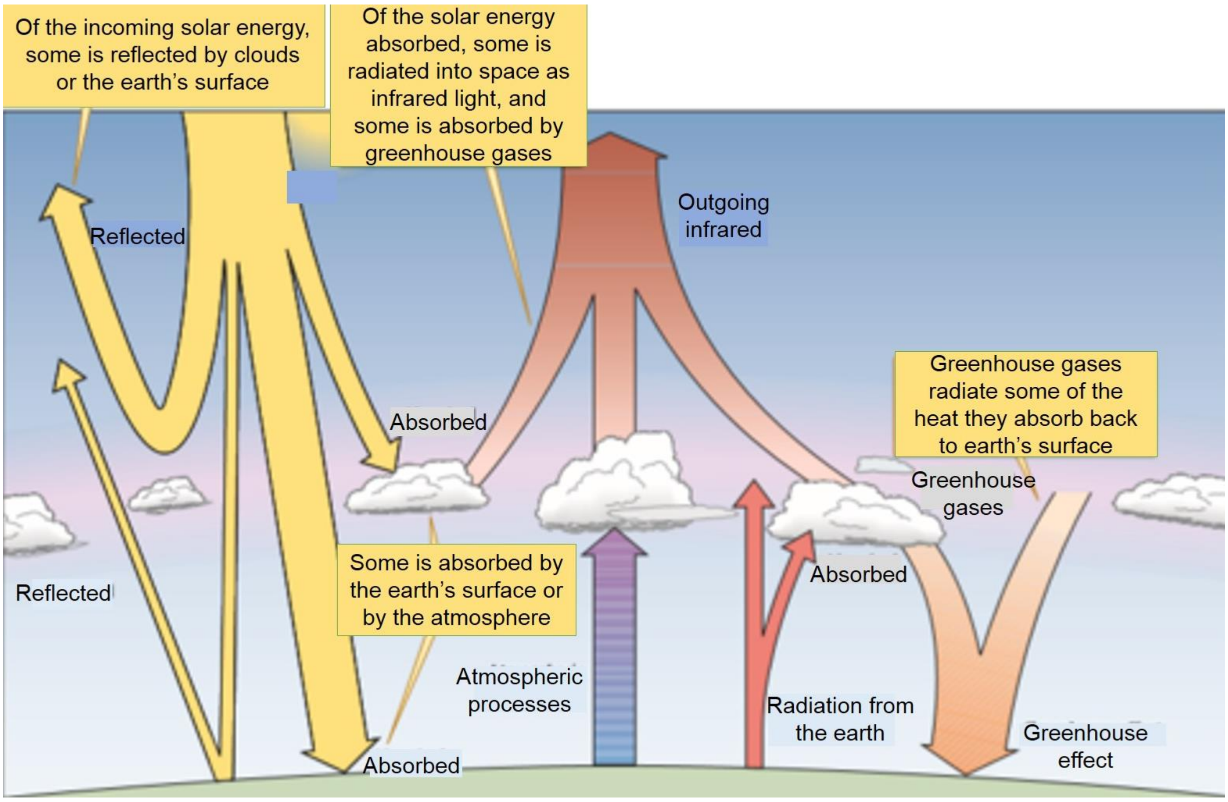

Figure 1 - The greenhouse effect: heat trapping by earth's atmosphere

Overpopulation. The population of the planet is reaching unsustainable levels as it faces shortage of resources like water, fuel and food. Population explosion in less developed and developing countries is straining the already scarce resources. Intensive agriculture practiced to produce food damages the environment through use of chemical fertilizer, pesticides and insecticides.

Loss of Biodiversity. Human activity is leading to the extinction of species and habitats and loss of biodiversity. Ecosystems, which took millions of years to perfect, are in danger when any species population is decimating. Balance of natural processes like pollination is crucial to the survival of the eco-system and human activity threatens the same.

Forests cover about 30% of the planet, but deforestation is clearing these essential habitats on a massive scale. What is deforestation?

Deforestation is clearing Earth's forests on a massive scale, often resulting in damage to the quality of the land.

The world's rain forests could completely vanish in a hundred years at the current rate of deforestation.

The biggest driver of deforestation is agriculture. Farmers cut forests to provide more room for planting crops or grazing livestock. Often, small farmers will clear a few acres by cutting down trees and burning them in a process known as slash and burn agriculture.

Logging operations, which provide the world's wood and paper products, also cut countless trees each year. Loggers, some of them acting illegally, also build roads to access more and more remote forests – which leads to further deforestation. Forests are also cut as a result of growing urban sprawl as land is developed for dwellings.

Not all deforestation is intentional. Some is caused by a combination of human and natural factors like wildfires and subsequent overgrazing, which may prevent the growth of young trees.

Deforestation is alarming, for example, tropical forests support half or more of earth's species and to influence global climate. Eliminating these forests may lead to losses of thousands of potentially useful species and substantial changes in world climate.

Ocean Acidification**.** It is a direct impact of excessive production of CO_2. 25% of CO_2 produced by humans. The ocean acidity has increased by the last 250 years but by 2100, it may shoot up by 150%. The main impact is on shellfish and plankton in the same way as human osteoporosis.

Acid rain occurs due to the presence of certain pollutants in the atmosphere. Acid rain can be caused due to combustion of fossil fuels or erupting volcanoes or rotting vegetation which release sulfur dioxide and nitrogen oxides into the atmosphere. Acid rain is a known environmental problem that can have serious effect on human health, wildlife and aquatic species.

Public Health Issues**.** The current environmental problems pose a lot of risk to health of humans, and animals. Dirty water is the biggest health risk of the world and poses threat to the quality of life and public health. Run-off to rivers carries along toxins, chemicals and disease carrying organisms. Pollutants cause respiratory disease like Asthma and cardiac-vascular problems. High temperatures encourage the spread of infectious diseases like Dengue.

Genetic modification of food using biotechnology is called genetic engineering. Genetic modification of food results in increased toxins and diseases as genes from an allergic plant can transfer to target plant. Genetically modified crops can cause serious environmental problems as an engineered gene may prove toxic to wildlife. Another drawback is that increased use of toxins to make insect resistant plant can cause resultant organisms to become resistant to antibiotics.

Answer these questions:

1. What does the word ecology come from?

2. Have people always understood the importance of their impact on the nature? Prove your opinion.

3. Is ecology a science? Why?

5. Which branches of science is ecology connected with?

7. Was Aristotle one of the first ecologists?

9. Who is often considered a father of ecology? Why?

10. How did ecology develop in the 19th century?

12. What was Suess's contribution to the development?

13. Who redefined the biosphere as the sum of all ecosystems in the 1920s?

14. When did the first ecological damages take place? Why?

15. Since what century has the term ecologist been in use?

16. When did ecology become the science of ecosystems?

17. What role does concentration of atmospheric CO2 play in the regulation of global temperature?

18. How does global warming affect your country?

19. What are the solutions you would advise to minimize greenhouse effect?

Topic: Organism and habitat. Primary abiotic factors and adaptations of organisms

Goal: to study the diversity of habitats, their characteristics, and features of adaptation of living organisms; to study the patterns of the influence of environmental factors on the vital activity and distribution of organisms.

Plan:

1. Habitats.
2. Environmental factors and their classification.
3. Adaptations of organisms
4. General laws of environmental factors effect on organisms. Limiting factors. Minimum law of Liebig, tolerance law of Shelford.
5. Primary abiotic factors and adaptations of organisms

Habitats

Habitat can be defined as a location in which a particular organism is able to conduct activities which contribute to survival and/or reproduction. This definition emphasizes the notion that the term habitat is organism-specific; that is, it focuses on the biotic and abiotic factors that affect the survival or reproduction of a particular type of organism, and on the areas that contain these factors. On our planet, living organisms have acclimated four basic habitats: aquatic, terrestrial, soil and organism as a habitat.

Water as a habitat has a variety of peculiar properties such as heavy density, heavy differential pressure, relatively low oxygen, strong absorption of sunburst, etc. Inhabitants of aquatic habitat are hydrobiontes. They inhabit ocean, inland bodies and underground water.

The ocean is categorized by several areas or zones (fig. 2).

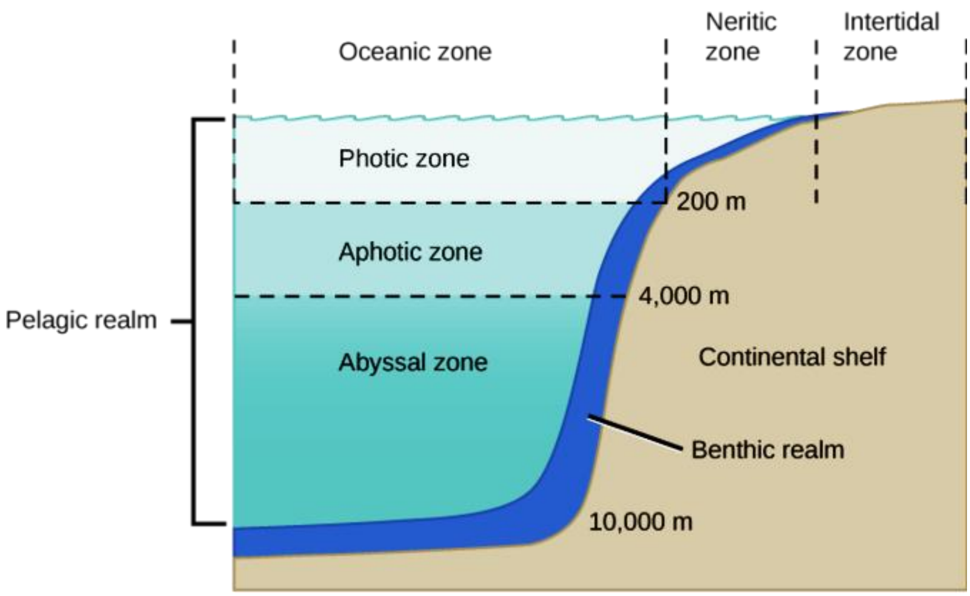

Figure 2 - Oceanic zones

All of the ocean’s open water is referred to as the pelagic realm (or zone). The benthic realm (or zone) extends along the ocean bottom from the shoreline to the deepest parts of the ocean floor. Within the pelagic realm is the photic zone, which is the portion of the ocean that light can penetrate (approximately 200 m). At depths greater than 200 m, light cannot penetrate; thus, this is referred to as the aphotic zone. The majority of the ocean is aphotic, lacking sufficient light for photosynthesis. The deepest part of the ocean, the Challenger Deep (in the Mariana Trench, located in the western Pacific Ocean), is about 11,000 m deep. To give some perspective on the depth of this trench, the ocean is, on average, 4267 m deep. These realms and zones are relevant to freshwater lakes as well, as they determine the types of organisms that will inhabit each region.

The main characteristics of aquatic habitat:

- Water-mass density. The pressure increases with depth about 1*105 Pa (1 atm.) for every 10 m. Water-mass density is the condition of soaring in water and many hydrobionts are adapted precisely to this way of life. Suspended, floating in the water organisms are united in a special ecological group of hydrobionts - plankton ("planktos" - soaring). The plankton consists of unicellular and colonial algae, protozoa, jellyfish, siphonophores, ctenophores, pteropodial and heteropodous mollusks, a variety of small crustaceans, benthic larvae, caviar and fish fry, and many others. A special kind of plankton is the ecological group of neuston ("nein" - to swim) - the inhabitants of the surface water film on the border with the air environment. The animals that are capable of rapid swimming and overcoming the strength of currents are united in the ecological group of nekton ("nectos" - floating). The representatives of nekton - fish, squid, dolphins.
- Oxygen condition. In oxygenated water its content does not exceed 10 ml per liter, this is 21 times lower than in the atmosphere. Oxygen enters the water mainly due to photosynthetic activity of algae and diffusion from the air. Therefore, the upper layers of the water column are, as a rule, richer in this gas than the lower ones. The breathing of hydrobionts is carried out either through the surface of the body, or through specialized organs - gills, lungs, trachea. In this case the integument can serve as an additional respiratory organ.
- The salt regime. Maintaining the water balance of hydrobionts has its own specifics. The excessive amount of water in the cells leads to a change in their osmotic pressure and disruption in vital functions. Freshwater forms can not exist in the seas, the sea ones do not tolerate desalination. If the salinity of the water is subjected to change, the animals move in search of favourable environment
- The temperature regime of reservoirs is more stable than on land. The amplitude of annual temperature fluctuations in the upper layers of the ocean is no more than 10-15°C, in continental reservoirs - 30-35 ° C. Deep layers of water are characterized by a constant temperature. In equatorial waters, the

average annual temperature of surface layers is + (26-27)°C, in polar waters - about 0°C and lower. In hot land sources, the water temperature can approach + 100°C, and in the underwater geysers at a high pressure at the ocean bottom the temperature of +380°C is recorded.

- Light conditions. Light in the water is much less than in the air. The rapid decrease in the amount of light with depth is due to the absorption of its water. The absorption of light is the stronger, the less the transparency of water, which depends on the number of particles suspended in it.

Terrestrial habitat is the most difficult on environmental conditions. Life on land required such adaptations, which were possible only if the level of organization of plants and animals was sufficient. Inhabitants of terrestrial habitat are aerobiontes.

The basic properties of terrestrial habitat:

- Gas structure of air in ground layer of atmosphere is homogeneous enough concerning the maintenance of the main components (nitrogen - 78,1 %, oxygen - 21 %, argon - 0,9 %, carbonic gas - 0,035 %) because of high diffused abilities of gases and constant intermixture by convection and wind flows.
- Ground properties and land topography also influence living conditions of land organisms, first of all plants. The properties of land surface having ecological influence on its inhabitants are edaphic factors of environment (from Greek «edaphos» - basis, soil).
- Climate features. The long-term mode of weather characterizes district climate. The concept climate includes not only average values of meteorological phenomena, but also their annual and daily course, deviations from it and their repeatability. The climate is defined by geographical conditions of area. For the majority of land organisms, especially small, the climate of area is not so important as conditions of their habitat. Very often local elements of environment (relief, exposition, vegetation, etc.) change the mode of temperature, humidity, light, air movement in a concrete site so that it considerably differs from region climate conditions. Such local climate modifications in air-ground interface are called microclimate.

Soil as a habitat. Soil structure results from the long-term interaction of climate, organisms, topography, and parent mineral material. Soil is a complex mixture of living and nonliving material upon which most terrestrial life depends. Inhabitants of soil are edaphobiontes.

Heterogeneity of conditions in soil is most sharply shown in a vertical direction. With depth a number of the major ecological factors influencing life of inhabitants of soil sharply changes. First of all it concerns soil structure. Soil structure can be observed by digging a soil pit, a hole in the ground 1 to 3 m deep. In a soil pit one can see one of the most significant aspects of soil structure, its vertical layering. Though soil structure usually changes gradually with depth, soil scientists generally divide soils into several discrete horizons. Soil profile is divided into O, A, B, and C horizons (fig. 3).

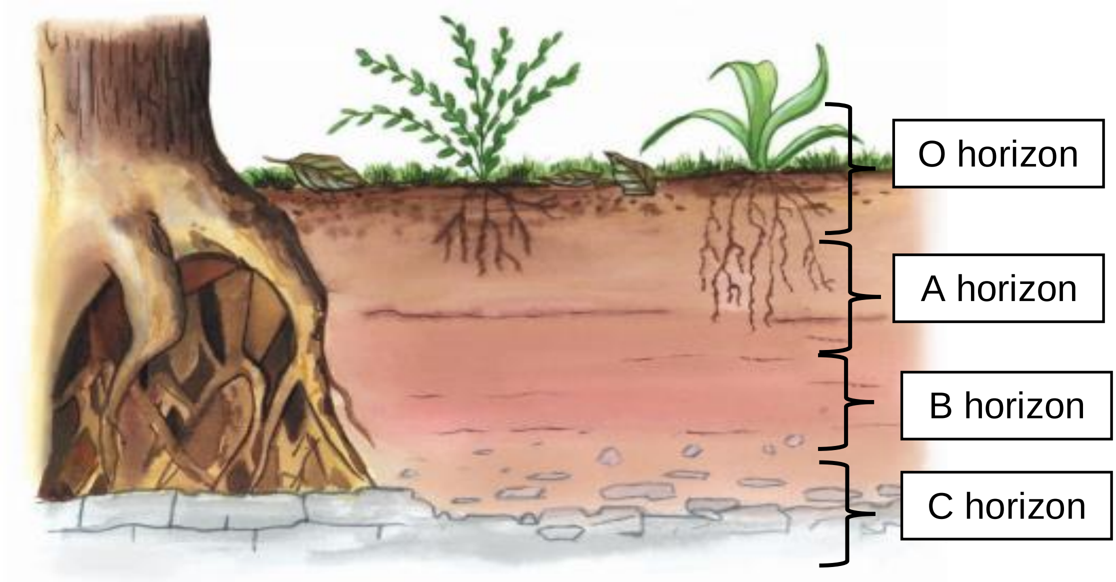

Figure 3 - Generalized soil profile, showing O, A, B, and C horizons

O - upper layer contains loose, somewhat fragmented plant litter. Litter in lower layer is highly fragmented.

A - mineral soil mixed with some organic matter. Clay, iron, aluminium, silicates, and soluble organic matter are gradually leached from A horizon.

B - depositional horizon. Materials leached from A horizon are deposited in B horizon. Deposits may form distinct banding patterns.

C - weathered parent material. The C horizon may include many rock fragments. It often lies on bedrock.

The moisture in soil is in various conditions:

1) combined water (hygroscopical and pellicular moisture) is strongly kept by the surface of soil particles;

2) capillary water occupies small pores and can move on them in various directions;

3) gravitational water fills larger emptiness and slowly filters downwards under the influence of gravity;

4) vaporous water is in soil air.

The structure of soil air is different. With depth the maintenance of oxygen strongly falls and concentration of carbonic gas increases. Because of the presence of decaying organic substances in soil air there can be a high concentration of such toxic gases as ammonia, hydrogen sulphide, methane, etc. While soil flooding or intensive rotting of plant residues, completely anaerobic conditions can arise in some places.

Temperature fluctuations are sharp only on a soil surface. Here they can even be stronger, than in a ground layer of air. However with each centimetre deep into daily and seasonal temperature changes become ever less and on depth of 1-1,5 m practically are not traced any more

Living organisms as a habitat. Many species of heterotrophic organisms throughout their life or part of the life cycle are found in other living beings whose bodies are used as a habitat, significantly different in properties from the outside. Virtually there is not a single species of multicellular organisms that do not have internal inhabitants. The higher the organisation of hosts, the greater the degree of differentiation of their tissues and organs, the more diverse the conditions they can provide to their cohabitants. Inhabitants of organisms are endobionts.

Environmental factors and their classification

Individual properties or environmental elements that affect organisms are called environmental factors. The environmental factors are diverse. They may be necessary or, on the contrary, harmful to living organisms, contribute to or hinder survival and reproduction.

Environmental factors can be combined according to the nature of their origin or according to their dynamics and effects on the body.

The factors of the nature origin are:

- Abiotic factors, due to the action of inanimate nature and are subdivided into the climatic (temperature, light, solar radiation, water, wind, acidity, salinity, fire, precipitation, and the like), orographic (elevation, slope, aspect), and geologic.
- Biotic factors - effect of some other organisms, including all the relationships between them. Each organism constantly experiences the direct or indirect influence of other creatures, comes into contact with representatives of its species and other species - plants, animals, microorganisms, depends on them and itself has an effect on them.
- Anthropogenic factors impact on wildlife of human activity. The activities of human society lead to some changes in nature as the habitat of other species or directly affects their lives. During the history of mankind the development of hunting first, and then of agriculture, industry, transport greatly changed the nature of our planet. The importance of anthropogenic impacts on the entire living world of the Earth continues to grow rapidly.

Adaptations of organisms

Biological adaptation is a structural, physiological process, or behavioral trait of an organism that has evolved incrementally through natural selection in response to increases in reproductive success in the organisms that showed those traits most strongly. There are major types of adaptations:

- Structural adaptations are special body parts of an organism that help it to survive in its natural habitat, for example, its skin colour, shape, and body covering.

- Behavioral adaptations are ways in which a particular organism behaves to survive in its natural habitat.
- Physiological adaptations are systems present in an organism that allow it to perform certain biochemical reactions optimally, while life-history adaptations are parametres affecting growth and reproduction such as age at sexual maturity, reproductive investment, body size, and longevity.

General laws of environmental factors effect on organisms. Limiting factors. Minimum law of Liebig, tolerance law of Shelford

The ability of an organism to survive and reproduce in a particular habitat depends on both the biotic and abiotic components of its environment. While the combination of all these components define the organism's ecological niche, the more specific term tolerance range can be used to define the maximum and minimum values of a particular abiotic variable that the organism can withstand.

Liebig's law of the minimum, often simply called Liebig's law or the law of the minimum, is a principle developed in agricultural science by Carl Sprengel (1828) and later popularized by Justus von Liebig. It states that growth is dictated not by total resources available, but by the scarcest resource (limiting factor).

The crop (production) depends on the factor which is in minimum. If in soil useful components as a whole represent the counterbalanced system and only any substance, for example, phosphorus, is in the quantities close to minimum it can lower crop. But it turned out that even the same mineral substances very useful at their optimum maintenance in soil, could reduce crop, if they are in excess. Thus, factors can be limiting, even being in maximum.

The limiting effect of the maximum was established by Shelford in 1913, and it is called Shelford's law of tolerance (fig. 4).

Favourable force of influence is called the optimum zone of the ecological factor or simply optimum for organisms of the given species. The stronger the deviations from optimum are, the stronger the oppressing influence of the given factor on organisms is (pessimum zone).

Maximum and minimum endurable levels of the factor are critical points outside of which existence is already impossible, there comes death.

Endurance limits between critical points are called ecological valence of living beings in relation to the concrete factor of environment.

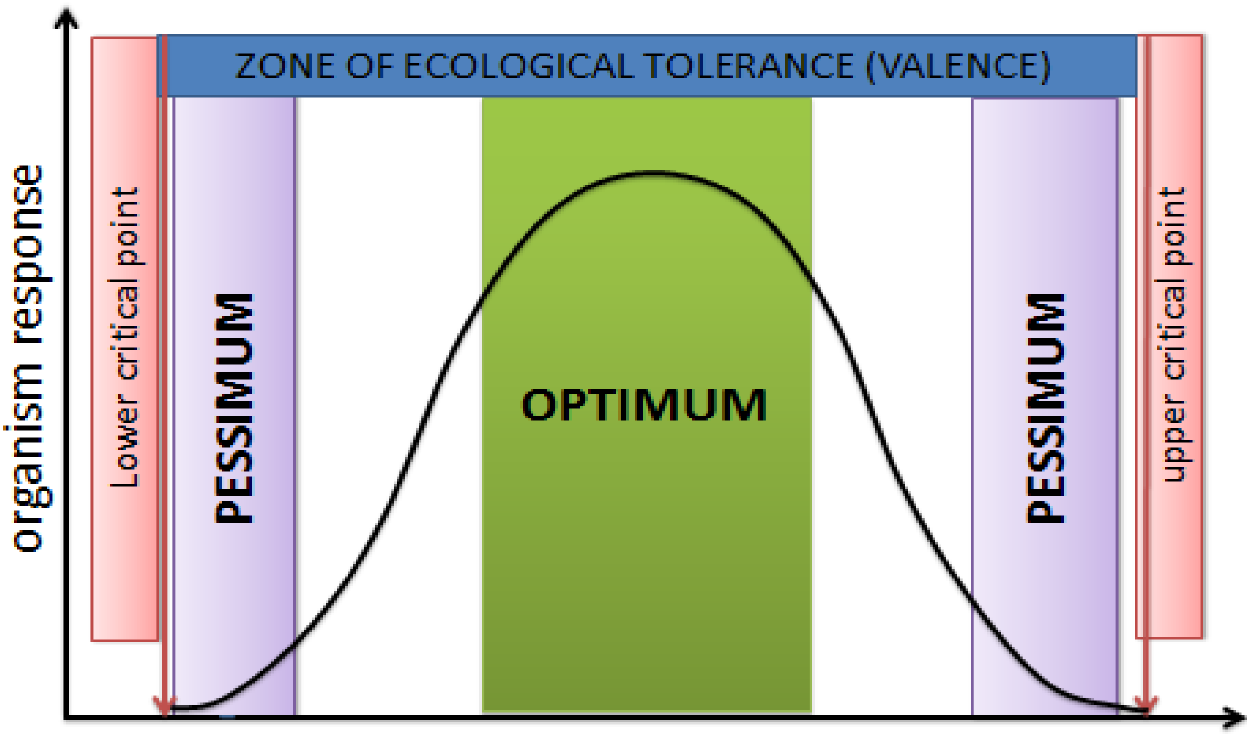

Figure 4 - Scheme of influence of environment factors on living organisms

The species which need certain ecological conditions for existence are called stenobiont, and those that are capable to adapt to different ecological conditions are called eurybiont.

Primary abiotic factors and adaptations of organisms

Primary abiotic factors are temperature, light and humidity. Adding the termination of "Phil" (Gr. I like) indicates that the species has adapted to high doses of factor. Adding «Phob» - to low doses of factor.

Vital activity of organisms essentially depends on the environmental temperature. Organisms living in stationary conditions of low temperatures are called cryophiles. Organisms living in stationary conditions of high temperatures are called thermophiles.

How can organisms regulate body temperature? So, first of all, many organisms do not. The body temperature of these organisms, called poikilotherms, varies directly with environmental temperatures. Of the organisms that regulate body temperature, most use external sources of energy and combination of anatomy and behaviour. Animals that rely mainly on external sources of energy for regulating body temperature are called ectotherms.

Organisms that rely heavily on internally derived metabolic heat energy are called endotherms. Among endotherms, birds and mammals use metabolic energy to heat most of their bodies. Other endothermic animals, including certain fish and insects, use metabolic energy to selectively heat critical organs. Endotherms that use metabolic energy to maintain a relatively constant body temperature are called homeotherms. The only homeothermic organisms are birds and mammals.

Light is the main source of energy for many ecosystems and a driving factor in fundamental ecological processes like photosynthesis and evapotranspiration. So, understanding and quantifying light effectively reaching Earth and living organisms can be of primary importance.

Plants may be classified ecologically according to their light requirements:

1) Sun-loving plants or heliophytes are adapted to a habitat with a very intensive insolation, because of the construction of its own structure and maintenance (metabolism). Special features of the plant include coarse tiny leaves with hairy and waxy protection against excessive light radiation and water loss.

2) Shade-loving or sciophytes are plants of the low layer of shady woods, caves and deep-water plants; they badly sustain the strong light of direct sun rays. Adaptation includes thinner leaves with a relatively higher chlorophyll content per unit leaf volume; lens-shaped epidermal cells that focus incoming light into and within the mesophyll;

3) Shade-tolerant plants can tolerate more or less shadowing, and grow well even in the light; they are capable of adapting to the influence of changing light conditions.

For animals the sunlight is not the necessary factor as for green plants as all heterotrophs finally exist at the expense of the energy saved by plants. There are different kinds of them: light-loving (photophilous) and shade-loving (photophobic); euryphotic adapted to a wide range of light exposure, and stenophotic adapted to limited light exposure conditions. Light for animals is the necessary condition for vision, visual orientation in space.

Freshwater is a vital resource for all living organisms. Most organisms have a water content of 50–90% and there is a critical threshold that they must maintain in order to survive and reproduce. Regardless of the environment, water availability is a driving force that shapes both aquatic and terrestrial species assemblages.

According to adaptation of land plants to short-term fluctuations of conditions of water supply and evaporation there are poikilohydric and homohydric plants.

Poikilohydric plants have not constant water ratio in tissues and it depends on degree of humidifying of environment. They cannot regulate transpiration, and easily and quickly lose and absorb water using moisture of dew, fogs, short rains; in dry condition they are in anabiosis.

Homohydric plants are capable to maintain relative constancy of tissues watering, among them is the majority of the higher land plants. The characteristic of them is a large central vacuole in cells. Thanks to it the cell always has water-supply and not so strongly depends on changeable environment conditions. Besides, shoots are covered from the surface by the epiderm with the low permeable for water cuticle; transpiration is regulated by stomatal mechanism, and well developed root system during vegetation can continuously absorb moisture from soil. As for the plants that can`t stand drying, they have various qualities to regulate the water exchange. Among them there are different in ecology groups:

Hydatophytes are aquatic plants, completely or mostly submerged in water. Some hydatophytes are not attached to the ground by their roots (duckweed and Canadian pondweed), and others (the waterlily) are attached. Hydatophytes are classified according to their course of development. True hydatophytes are plants submerged in water, and their growth and development occur only in water (some species of Ceratophyllaceae). Submerged aerohydatophytes are plants totally submerged in water; their growth occurs in water, but the pollination of their flowers takes place above water (spiral wild celery). Floating aerohydatophytes are plants a part of whose leaves and stems is immersed in water and the other part of which floats. The pollination of their flowers occurs above water. Many hydatophytes turn into peat. Their stomata are reduced and there is no cuticle.

A plant that grows wholly or partly submerged in water. Because they have less need to conserve water, hydrophytes often have a reduced cuticle and fewer stomata than other plants. Floating leaves have stomata only on their upper surfaces, and underwater leaves generally have no stomata at all. Because water is readily available, hydrophytes also have a reduced root system and less vascular tissue than other plants (which also makes plant parts less dense and helps them float). Hydrophytes tend to have less supportive tissue as well, since they are buoyed by water. Many species of hydrophytes (such as the Eurasian milfoil) have divided leaves that have less resistance to flowing water. The lotus, water lily, and cattail are hydrophytes.

A Hygrophyte is a plant living above ground that is adapted to the conditions of abundant moisture pads of surrounding air. These plants inhabit mainly wet and dark forests and islands darkened swamp and very humid and floody meadows. Within the group of all types of terrestrial plants, they are at least resistant to drought. According to the environmental attributes are a group of plants between categories hydrophytes (aquatic plants) and mesophytes (plants in moderate environmental conditions).

Mesophytes are adapted to short and not so strong drought. These are the plants growing at average humidifying, moderately warm mode and with good supply of mineral food. These are evergreen trees of the upper layers of rainforests, deciduous trees of savannas, tree species of damp evergreen subtropical woods, deciduous hardwoods of moderate belt, underbrush bushes, grassy plants of nemorose wideherbs, plants of flooded and not too dry meadows, deserted ephemers and ephemeroids, many weed plants and the majority of cultivated plants.

A xerophyte is a plant that has adapted to survive in an environment with little liquid water, such as a desert or an ICE - or snow-covered region in the

Alps or the Arctic. The morphology and physiology of xerophytes are variously adapted to conserve water, and commonly also to store large quantities of water during dry periods.

Xerophytes are divided into two main types: succulents and sclerophytes.

Succulent plants store water in their stems or leaves. They include the Cactaceae family which has round stems and can store a lot of water. The leaves are often vestigial, as in the case of cacti, wherein the leaves are reduced to spines, or they do not have leaves at all.

Sclerophytes are plants, on the contrary, dry by sight, often with the narrow and small leaves sometimes curtailed into a tubule. Leaves can be also parted, covered by hairs or wax bloom. Sucking force of roots to several tens of atmospheres allows to extract successfully water from soil.

Answer these questions:

1. How many types of environmental factors are there? Name it.
2. Why is an organic horizon generally absent from desert soils?
3. Give examples of aquatic habitat inhabitants
4. Give examples of terrestrial inhabitants
5. Give examples of soil inhabitants
6. Name the limiting factors of aquatic habitat.

Topic: Population Ecology

Goal: to develop an idea of the students about the main characteristics of the population; to study the biological and ethological structure of the population; to develop the skills to identify the dynamics of the population

Plan:

1. Concept “population”
2. Biological structure of populations
3. Ethological structure of populations.
4. Population dynamics

Concept “population”

Population ecology is a sub-field of ecology that deals with the dynamics of species populations and how these populations interact with the environment.

Term “population” comes from Latin word populous (people) and in translation means “population”. Ecologists usually define a population as a group of individuals of a single species inhabiting a specific area. A population of plants or animals might occupy a mountaintop, a river basin, a coastal marsh, or an island, all areas defined by natural boundaries.

Population - this is the group of one species individuals inhabiting certain territory and characterizing by this or other level of genetic information exchange (panmixture), morphobiological type and system of sustainable functional ties.

Ecologists study populations for many reasons. Population studies hold the key to saving endangered species, controlling pest populations, and managing fish and game populations. They also offer clues to understanding and controlling disease epidemics.

Populations, as groups, have a number of specific features that are not inherent in a single species.

Main characteristics of the population:

Abundance: Absolute number of individuals in population. The abundance of an organism, often considered as total population size or the number of organisms in a particular area (density), is one of the basic measures in ecology. Organisms generally are more abundant where conditions are favorable, such as locations with sufficient quantity and quality of food or nutrients, fewer herbivores or predators, fewer competitors, and optimal physical features. The physical features that affect abundance could be substrate type, moisture, light, temperature, pH, salinity, oxygen or CO2, wind, or currents.

Density of population is the number of individuals per unit area or volume. It is expressed when the size of individuals in the population is relatively uniform.

Fertility (natality) refers to the rate of reproduction or birth per unit time. It is an expression of the production of new individuals in the population by birth, hatching, germination or fission.

Mortality: the number of deaths in a population per unit time. The loss of individuals due to death in a population under given environmental conditions is called mortality. Mortality as well as fertility especially of higher organisms varies widely with age.

Population growth - the difference between fertility and mortality. Population growth can be either positive or negative.

Growth rate - is the amount or speed of increase in size of population (per unit time).

The population has a certain organization. The distribution of species in the territory, correlation of groups according to sex, age, morphological, physiological, behavioral and genetic characteristics represent **the structure of the population**. It is formed, on the one hand, on the basis of the general biological features of the species, and on the other hand - under the influence of abiotic factors of the environment and populations of other species.

Biological structure of populations

The structure of the population is not stable. Growth and development of organisms, birth of new organisms, death from various causes, changing environmental conditions, increasing or decreasing number of enemies - all these lead to a change in various relations within the population. The direction of further changes in population largely depends on what structure of the population in a given period of time is.

<u>Sexual structure of populations</u>

The sex ratio of species and especially the proportion of proliferative females in the population are of great importance for the further growth of its numbers. The sex ratio in the population is established not only by genetic laws, but also under the influence of the environment. In some species, sex is initially determined not by genetic, but by environmental factors. For example, in the case of red forest ants (Formica rufa), the eggs laid at temperatures below +20°C develop males, at a higher level - almost exclusively females. The sex of Arisaema japonica plants depends on the accumulation of nutrients in the tubers. Plants with female flowers grow from large tubers, and from small tubers - males.

<u>Age structure.</u> Age distribution is another important characteristic of population, which influences natality and mortality. Mortality usually varies with age, as chances of death are more in early and later periods of life span. Similarly, natality is restricted to certain age groups, as for example, in middle age-groups in higher animals. According to Bodenheimer (1958), the species of a population can be divided into pre-reproductive, reproductive and post-reproductive groups. The species of pre-reproductive group are young, those

of reproductive group are mature and those in post-reproductive group are old. The ratio of various age groups in a population determines the reproductive status of the population. Rapidly increasing population contains a large proportion of young species, a stable population shows even distribution of species in reproductive age-group and a declining population contains a large proportion of old species.

The age state of the species is the stage of its ontogeny, at which it is characterized by definite relations with the environment. With age, the requirements of the species to the environment and the resistance to its individual factors naturally change very substantially. At different stages of ontogeny, habitat changes, changes in the type of nutrition, the nature of movement, and the overall activity of organisms can occur. Often the age-related ecological differences within the species are expressed to a much greater extent than the differences between species. For example, grass frogs on land and their tadpoles in water bodies, caterpillars, gnawing leaves, and winged butterflies sucking nectar are just different ontogenetic stages of the same species.

Three ecological age groups can be distinguished in the population:

- ✓ Preproductive
- ✓ Reproductive
- ✓ Post-productive

The duration of these ages in relation to the overall life expectancy varies greatly among different organisms.

In plants, the age structure of the cenopopulation, i.e., the population of a particular phytocenosis, is determined by the ratio of age groups.

For example, trees have both multiple life stages (seed, plant) and age classes within the plant stage (i.e., seedling, sapling, mature tree).

Analysis of the age structure helps to predict the population size during the life of the next generations.

<u>Spatial distribution of populations</u>

Organisms do not occur randomly in space. Any species of plant or animal may be found in some areas, while they are completely absent from others. Likewise, the individuals of any species are distributed in relation to each other in distinct patterns. The reasons for the readily apparent nonrandomness of the spatial distribution patterns of organisms are numerous, and the patterns result from processes acting throughout the whole life cycle of the organism, and on various spatial scales. Interactions between individuals and across species all take place in space as well as in time, and an understanding of spatial patterns is basic to understanding real-life ecological processes. Indeed, patterns of spatial distribution play an important role in shaping a wide range of ecological dynamics, such as intra- and interspecific competition, mating systems, predation, population genetics, and the spread of contagious diseases.

While there are few environments on earth without life, no single species can tolerate the full range of earth's environments. For each species, some environments are too warm, too cold, too saline, or unsuitable in other ways. At some point, the metabolic costs of compensating for environmental variation may take up too much of an organism's energy budget. Partly because of these energy constraints, the physical environment places limits on the distributions of populations. The environmental limits of a species are related to its niche. To the ecologist, the niche summarizes the environmental factors that influence the growth, survival, and reproduction of a species. In other words, a species' niche consists of all the factors necessary for its existence — approximately when, where, and how a species makes its living.

Three basic patterns of distribution: random, regular, or clumped.

A random distribution is one in which individuals within a population have an equal chance of living anywhere within an area.

A regular distribution is one in which individuals are uniformly spaced.

In a clumped distribution, individuals have a much higher probability of being found in some areas than in others (fig. 5).

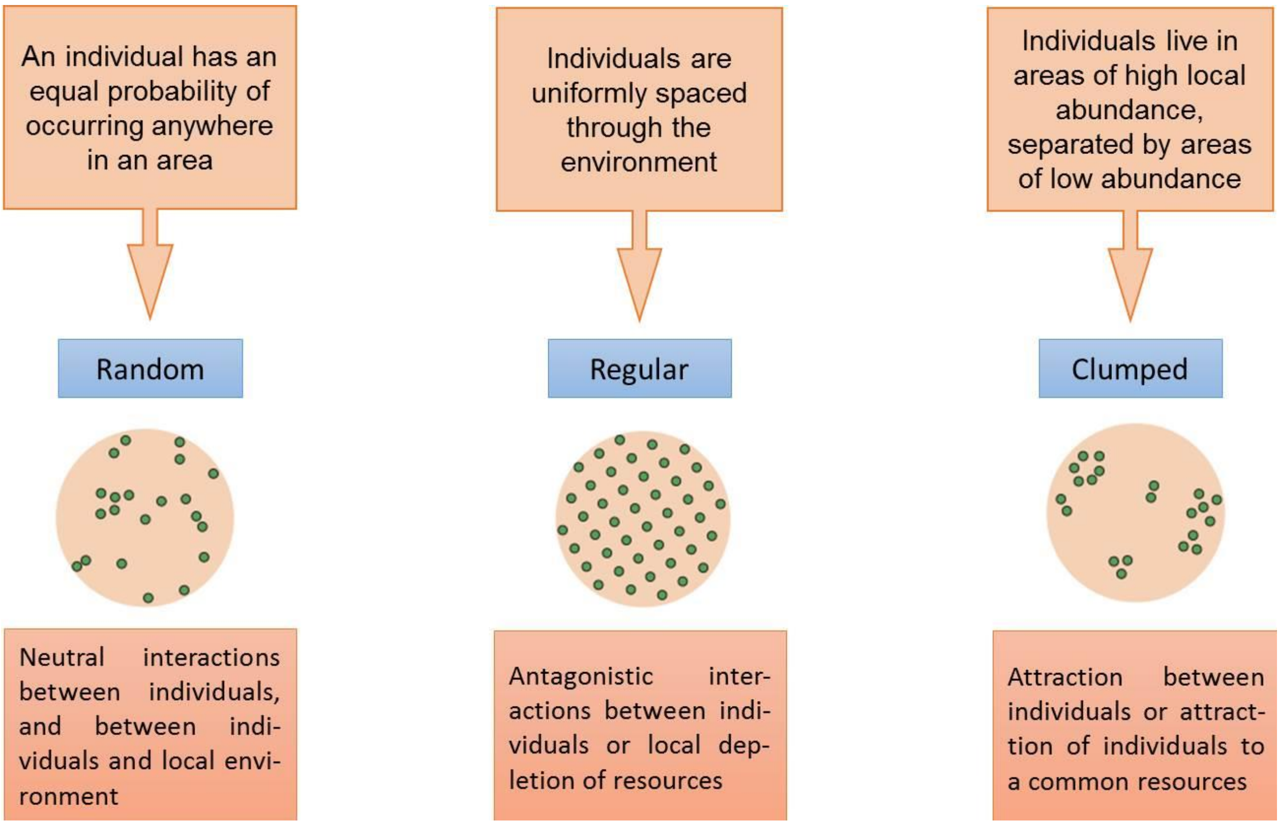

Figure 5 - Spatial distribution of populations

These three basic patterns of distribution are produced by the kinds of interactions that take place between individuals within a population, by the structure of the physical environment, or by a combination of interactions and environmental structure. Individuals within a population may attract each other, repel each other, or ignore each other. Mutual attraction creates clumped, or aggregated, patterns of distribution. An environment with patchy distributions of nutrients, nesting sites, water, and so forth fosters clumped distribution patterns. An environment with a fairly uniform distribution of resources and frequent, random patterns of disturbance (or mixing) tends to reinforce random or regular distributions.

Ethological structure of populations

The ethological or behavioral structure of the population is the system of relationships between members of one population.

Behavior of animals in relation to other members of the population depends primarily on whether a single or group way of life is peculiar to the species. The forms of joint existence of species in the population are extremely different.

A single way of life, at which the species of a population are independent and separate from each other, is typical for many species, but only at certain stages of the life cycle. Completely solitary existence of organisms in nature does not occur, since in this case it would be impossible to carry out their basic life function - reproduction. However, some species are characterized by very weak contacts between cohabiting individuals. These are, in particular, individual aquatic inhabitants with an external method of fertilization, in which there is no need to directly meet partners, for example, single actinia.

Family way of life. In the family way of life, the ties between parents and their generation are strengthened. The simplest kind of such connection is the care of one of the parents about the laying eggs: protection of the egg laying, incubation, additional aerating, etc.

In the family way of life the territorial behavior of animals is obviously expressed: various signals, marking, ritual forms of threat and direct aggression ensure possession of a site sufficient for rearing generation.

The larger groups of animals are flocks, herds and colonies. At the heart of their formation lies the further complication of behavioral links in populations.

Colonies. These are group settlements of sedentary animals. They can exist for a long time or arise only for the period of reproduction, as, for example, with many birds - rooks, gulls, loons, puffins, etc. The complexity of the interrelationships between species of the colony of animals is extremely varied - from simple territorial aggregations of single forms to associations, where individual members perform, as organs in a coherent organism, different functions of species life.

The most complex colonies of social insects - termites, ants, bees. They arise on the basis of a greatly expanding family. In such colonies-families insects perform together most of the basic functions: reproduction, protection, provision of food for themselves and their generation, construction, etc.

Flocks (shoals, packs). These are temporary associations of animals that exhibit a biologically useful organization of actions. Flocks facilitate the performance of any function in the life of the species: protection from enemies, getting food, migration. The aggregating behavior is common among birds and fish, as for mammals it is common for many canids. Imitative reactions and orientation toward neighbors are highly developed in the flocks.

Herds. These are longer and more permanent animal associations than flocks. In herd groups, as a rule, all the basic functions of the life of the species are realized: foraging, protection from predators, migration, reproduction, rearing of young animals, etc. The basis of group behavior of animals in herds is the relationship of dominance-subordination based on individual differences between species.

Optimization of physiological processes leading to viability increase in the joint existence, was called the effect of the group. Life in the group through the nervous and hormonal systems is reflected in the course of many physiological processes in the animal's body. Isolated species have changes in metabolic rate, faster usage of reserve substances, viability decrease; they haven`t a number of instincts.

Population Dynamics

In nature populations are in continuous flux and their patterns of distribution and abundance result from a dynamic balance between factors that add species to populations, and factors that remove species from populations.

The dynamic population processes underlying distribution and abundance are the subject of ecology population dynamics, which is concerned with the factors influencing the expansion, decline, or maintenance of populations.

General changes in population size are due to four phenomena: fertility, mortality, immigration and emigration of species.

The distinction is made between the absolute and specific fertility. The first one is characterized by the total number of born species. For example, if in a reindeer population of 16,000 animals, 2,000 deer appeared during the year, this number also expresses the absolute fertility. The specific one is calculated as the average change in the number of species per specific time interval (in this case, it is one newborn per 8 members of the population for the year).

The size of the fertility depends on many factors. Great importance is given to the proportion of species capable to reproduction at a given period that is determined by the ratio of sexes and age groups.

Mortality in populations also depends on many factors: the genetically programmed life expectancy of species, their genetic and physiological usefulness, the impact of unfavorable physical conditions of the environment, the impact of predators, parasites, diseases, etc. These factors are different at different stages of the life cycle of each generation.

Emigration: It is one way movement of species out of the population. This movement is permanent and causes spread of a species to new areas. Emigration under natural conditions occurs when there is overcrowding in the population and is generally regarded as an adaptive behaviour that regulates the population on a particular site and prevents over-exploitation of the habitat.

This type of dispersal offers new opportunity to the species of a population to interbreed with those of the other population leading to more genetic heterozygosity and adaptability.

Immigration: This is one way movement of species into the population. It leads to rise in density of population. It may result in decreased mortality among the immigrants or decreased reproductive capacity of the species.

There are two fundamentally different aspects of population dynamics: modification and regulation.

<u>Modification</u> is a random deviation of numbers resulting from a variety of factors not related to population density.

<u>Regulation</u> is the return of population after deviation to the initial state, which occurs under the influence of factors determined by population density.

Modifying factors, causing changes in the number of populations, do not themselves experience the impact of these changes. Thus their action is one-sided. These factors include all the abiotic influences of the environment on organisms, the quality and quantity of their food, etc. Favorable weather conditions can cause a massive outbreak of species reproduction and overpopulation of the territory occupied by it, as, for example, in the case of herd locusts. The negative impact of modifying factors, on the contrary, reduces the population size sometimes to its complete disappearance.

Regulatory factors do not simply change the population size, but smooth out its fluctuations, bringing after regular deviation from the optimum to the previous level. This happens because the effect of their impact is more stronger if population density is higher. The regulatory forces are inter-specific and intraspecific interactions of organisms.

The study of factors that affect growth, stability and decline of populations is population dynamics. All populations undergo three distinct phases of their life cycle:

- growth;
- stability;
- decline.

Population growth occurs when available resources exceed the number of species able to exploit them. Reproduction is rapid, and death rates are low, producing net increase in the population size. Population stability is often proceeded by «crash» since the growing population eventually outstrips its available resources. Stability is usually the longest phase of population's life cycle. Decline is the decrease in the number of species in population, and eventually leads to population extinction. Nearly all populations will tend to grow exponentially as long as there are resources available. Most populations have the potential to expand at an exponential rate, since reproduction is generally a multiplicative process. Two of the most basic factors that affect the rate of population growth are the birth rate, and the death rate. The intrinsic rate of increase is the birth rate minus the death rate.

Two modes of population growth (fig. 6).

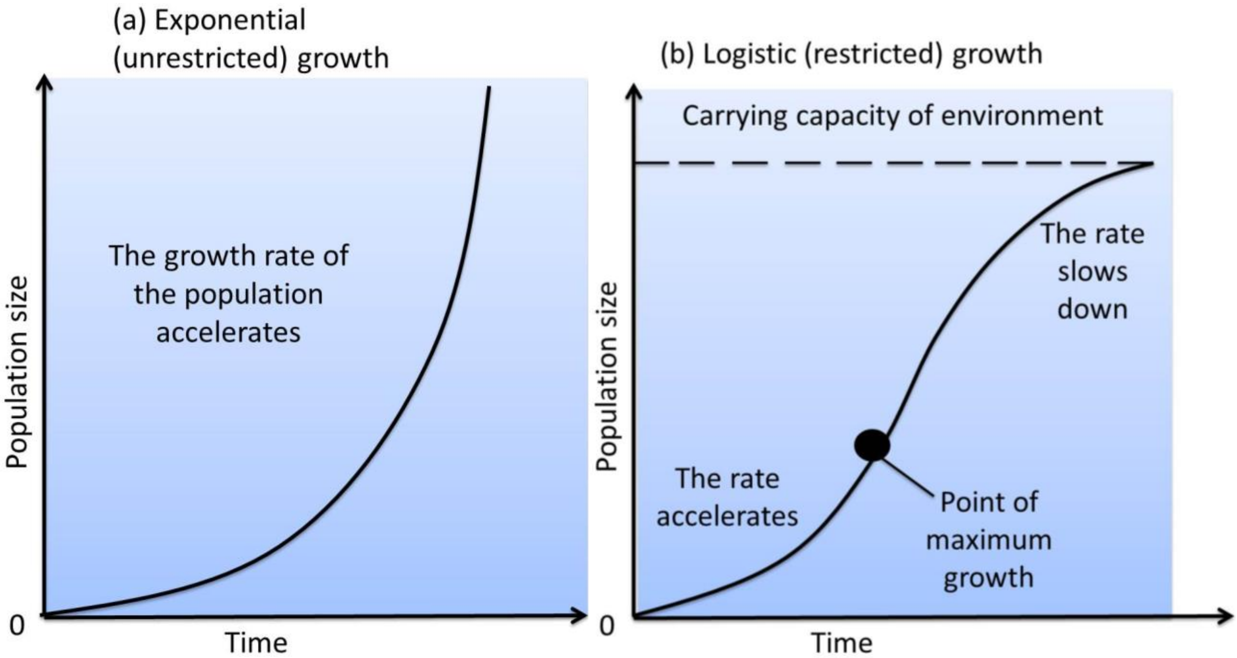

Figure 6 - Population growth

The Exponential curve (also known as a J-curve) occurs when there is no limit to population size. The Logistic curve (also known as an S-curve) shows the effect of a limiting factor (in this case the carrying capacity of the environment).

The environment is the ultimate cause of population stabilization. Two categories of factors are commonly used: physical environment and biological environment. Three subdivisions of the biological environment are competition, predation, and symbiosis. Physical environment factors include food, shelter, water supply, space availability, and (for plants) soil and light. One of these factors may severely limit population size, even if the others are not as constrained. The Law of the Minimum states that population growth is limited by the resource in the shortest supply. Extinction is the elimination of all individuals in a group. Local extinction is the loss of all individuals in a population. Species extinction occurs when all members of a species and its component populations go extinct. Scientists estimate that 99 % of all species that ever existed are now extinct. The ultimate cause of decline and extinction is environmental change. Changes in one of the physical factors of the environment may cause the decline and extinction; likewise the fossil record indicates that some extinctions are caused by migration of a competitor. Dramatic declines in human population happen periodically in response to an infectious disease. Bubonic plague infections killed half of Europe's population between 1346 and 1350, later plagues until 1700 killed one quarter of the European populace. Smallpox and other diseases decimated indigenous populations in North and South America. Human populations have continued to increase, due to use of technology that has disrupted natural populations. Destabilization of populations leads to possible outcomes: – population growth as previous limits are removed; – population decline as new limits are imposed. Agriculture and animal domestication are examples of population increase of favored organisms. In England alone more than 300,000 cats are put to sleep per year, yet before their domestication, the wild cat ancestors were rare and probably occupied only a small area in the Middle East.

Answer these questions:

1. List ecological age groups of animals population.
2. What are the herds?
3. What are the basic patterns of distribution of the population?
4. How may a species respond to climate change?
5. How might biological and physical aspects of the environment interact to influence a species' geographic distribution?
6. What is the density of population?
7. What is the natality of population?

Topic: Communities and ecosystems

Goal: to develop understanding of the main characteristics of the biocenosis; to study the features of the relationship between organisms; to develop skills to identify the distinctive features between natural and agroecosystems.

Plan:

1. Structure of the biocenosis
2. Species interactions
3. The concept of the ecosystem and biogeocoenosis.
4. Food web structure
5. Succession and stability
6. Agroecosystems

Structure of the biocenosis

Each organism lives in the environment of others, have diverse relations with both negative and positive consequences for themselves and ultimately can not exist without this living environment.

Interaction with other organisms is the necessary condition for nutrition and reproduction, the possibility of protection, mitigation of adverse environmental conditions, and on the other hand, it is danger of harm and often even immediate threat to the existence of the individual.

The immediate living environment of the organism is its **biocenotic environment**. Representatives of each species are able to exist only in such living environment where connections with other species provide them with normal living conditions. In other words, diverse living organisms are found on the Earth not in any combination, but form certain cohabitations, or communities, which include species adapted to co-habitation.

Groups of coexisting and mutually related species are called **biocenoses** (from Latin "bios" - life, "cenosis" - common).

The concept "biocenosis" is one of the most important in ecology. This term was proposed in 1877 by the German hydrobiologist K. Möbius. The study of the regularities of the addition and development of biocenoses led to the uprise of the special division of the general ecology - **biocenology**.

The scale of biocenotic groupings of organisms is very different, from communities of lichen cushions on tree trunks or decaying stumps to the population of whole landscapes: forests, steppes, deserts, etc.

The structure of any system means regularities in the relationship and connections of its parts. The structure of the biocenosis is multifaceted, and the different aspects are distinguished in its study.

There is distinction between such concepts as "species wealth" and "species diversity" of biocenosis. **Species wealth** – is a total number of species which is expressed in the lists of representatives of different groups of organisms. **Species diversity** is an indicator that reflects not only the quality of the biocenosis, but also the quantitative relationships of species.

Biocenoses could be poor and rich in species. What is more the species composition of biocenoses depends on duration of their existence, and history of each biocenosis. Young, emerging communities usually include a smaller set of species than long established, mature ones. Biocenoses created by man (fields, gardens, vegetable gardens) are also poorer in species than similar natural systems (forest, steppe, meadow). The uniformity and species poverty of agrocenoses are supported by special complex system of agrotechnical measures - control of weeds and pests of plants.

Almost all terrestrial and most aquatic biocenoses include microorganisms, plants, and animals. However, under certain conditions, biocenoses are formed in which there are no plants (for example, in caves or water bodies below the photic zone), and in exceptional cases - consisting only of microorganisms (for example, in an anaerobic environment at the bottom of reservoirs, rotting ooze, hydrogen sulphide sources, etc.).

The species of the same dimensional class which are part of a single biocenosis vary greatly in number. Some of them are rare, others are so frequent that determine the external appearance of the biocenosis. Species prevailing in numbers are the **dominants** of the community. Among them there are those which by their vital activity create the environment for the entire community, and without which the existence of most other species is impossible. Such species are called **edificators** (literal translation from Latin - builders). The main edificators of terrestrial biocenoses are some plant species: in spruce forests - spruce, in pine forest - pine, in the steppes - sod grasses (stipas, fescue grass, etc.). However, in some cases, animals can also be edificators. For example, in the territories occupied by the marmot colonies, it is their digging activity that determines mainly the nature of the landscape, the microclimate, and the conditions for the growth of plants. In the seas, typical edificators among animals are reef-forming coral polyps.

That part of the abiotic environment that the biocenosis occupies is called the biotope, i.e., the biotope is the habitat of the biocenosis (from Latin bios - life, topos - place).

The spatial structure of terrestrial biocenosis is determined primarily by the addition of its plant part - phytocenosis, distribution of upper and underground masses of plants.

During the cohabitation of plants, different in height, the phytocenosis often acquires a clear tiered **layering.** For example, the vertical layering of a forest: layers from top to bottom consist of the upper canopy, the low-tree layer, the shrub understory, the ground layer of herbaceous plants, the forest floor, and the root layer.

Species interactions

The basis of emergence and existence of biocenoses is the relations of organisms, the contacts they have with each other inhabiting the same biotope. These contacts determine the basic conditions of species life in the community, the possibilities of obtaining food and conquering new space.

One popular approach is assessment of possible outcomes of contacts of two species. For each of them the result is taken as positive, negative or neutral.

Predation is one of the possible forms of energy transfer from living animal to living animal. In terms of behavior, it is the process through which an animal (the predator) captures and kills another animal (the prey) before eating the latter in part or completely. The concept of predation does not apply to interspecific relationships where one of the partners is not an animal. In particular, it excludes insectivorous plants as well as plant-eating animals.

Parasitism - relationship in which one organism (the parasite) benefits at the expense of the other organism (the host). The body-consumer uses in live host not only as food source, but also as a place of permanent or temporary residence. In fact, the typical parasitic nature has links pests with plants. Parasites are usually much smaller than its master.

Competition is an interaction between two or more species, which exploit the same resources, accessible in a limited amount. These interactions are negative since they diminish the amount of resources available to others or prevent others from obtaining them or both. There is interspecies and intraspecies competition.

Commensalism - a symbiotic relationship in which one organism benefits and the organism is not affected. Commensalism based on the consumption of residues of food hosts is also called scavenger. Such, for example, the relationship of lions and hyenas, pick up the remains of prey eaten by lions. Relationship type commensalism is very important in nature, as promote closer cohabitation species, a fuller exploration of the environment and the use of food resources.

Mutualism - is a symbiotic relationship in which both organisms benefit. Because the two organisms work closely together, they help each other survive.

In multicellular plants and animals symbiosis with microorganisms is widespread. Known coexistence of many species of trees with mycorrhizal fungi, legumes with nodule bacteria Rhizobium, fixing the molecular nitrogen from the air. Other examples - bacteria which the ability to digest wood, live within the digestive tracts of termites; plant roots provide food for fungi that break down nutrients the plant needs.

Neutralism is a form of biotic relation in which the cohabitation of two species in one area does not attract them either positive or negative effect.

When neutrality species are not associated with each other directly, but depend on the state of the community as a whole.

In the case of **amensalism**, for one of the two interacting species, the effects of cohabitation are negative, while the other does not receive any harm or benefit. This form of interaction is more common in plants. For example, light-loving herbaceous species growing under a spruce, experience oppression as a result of strong shadowing of its crown, whereas for the tree their neighborhood may be indifferent.

The concept of the ecosystem and biogeocoenosis

The first principle of ecology is that each living organism has an ongoing and continual relationship with every other element that makes up its environment. An ecosystem can be defined as any situation where there is interaction between organisms and their environment.

An ecosystem, a contraction of «ecological» and «system», refers to the collection of components and processes that comprise and govern the behavior of some defined subset of the biosphere. The term is generally understood to refer to all biotic and abiotic components and their interactions with each other in some defined area, with no conceptual restrictions on how large or small that area can be.

There are two main components of all ecosystems: abiotic and biotic.

Abiotic, or nonliving, components of an ecosystem are its physical and chemical components, for example, rainfall, temperature, sunlight, and nutrient supplies.

One of the problems with modern society is that it changes environmental conditions, making regions hotter or drier, for example. Such changes can make life more difficult, if not impossible, for other organisms.

Biotic components of an ecosystem are its living things – fungi, plants, animals, and microorganisms. Organisms live in populations, groups of the same species occupying a given region. Populations never live alone in an ecosystem. They always share resources with others, forming a community (a group of organisms living in the given area).

The ecosystem is composed of two entities, the entirety of life, the biocoenosis and the medium that life exists in, the biotope. Within the ecosystem, species are connected by food chains or food webs. Energy from the sun, captured by primary producers via photosynthesis, flows upward through the chain to primary consumers (herbivores), and then to secondary and tertiary consumers (carnivores), before ultimately being lost to the system as waste heat. In the process, matter is incorporated into living organisms, which return their nutrients to the system via decomposition, forming biogeochemical cycles such as the carbon and nitrogen cycles.

The concept of an ecosystem can be applied to units of variable size, such as a pond, a field, or a piece of deadwood. A unit of smaller size is called a microecosystem. For example, an ecosystem can be a stone and all the life under it. A mesoecosystem could be a forest, and a macroecosystem a whole ecoregion, with its drainage basin.

The main questions when studying an ecosystem are:

- Whether the colonization of a barren area could be carried out.
- Investigation of the ecosystem's dynamics and changes.
- The methods of which an ecosystem interacts at local, regional and global scale.
- Whether the current state is stable.
- Investigating the value of an ecosystem and the ways and means that interaction of ecological systems provides benefit to humans, especially in the provision of healthy water.

Ecosystems have become particularly important politically, since the Convention on Biological Diversity – ratified by more than 175 countries – defines «the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings» as one of the binding commitments of the ratifying countries. This has created the political necessity to spatially identify ecosystems and somehow distinguish among them. The CBD defines an «ecosystem» as a «dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit».

For this purpose, ecosystems can be characterized and mapped as physiognomic ecological units, originally developed for vegetation classification. Each vegetation structure reflects ecological conditions. Each ecosystem thus defined, hosts assemblages of species with survival strategies that can survive under its conditions. This is not only true for plant species, but for all species, flora, fauna and fungi alike, as each species responds to the characteristic ecological conditions of each location. This principle allows us to map ecosystems using the UNESCO physiognomic ecological classification system, the Land Cover Classification Systems (LCCS) developed by the FAO and the United States National Vegetation Classification system (USNVC). The size and scale of an ecosystem can vary widely. It may be a whole forest, a community of bacteria and algae in a drop of water, or even the geobiosphere itself. As most of these borders are not rigid, ecosystems tend to blend into each other. As a result, the whole earth can be seen as a single ecosystem, while a lake can be divided into several ecosystems, depending on the scale used.

Early conceptions of this unit showed a structured functional unit in equilibrium of energy and matter flows between its constituent elements. Others considered this vision limited, and preferred to understand an ecosystem in terms of cybernetics. From this point of view an ecological system is a functional dynamic organization, or what was also called «steady state». Steady state is understood as the phase of an ecological system's evolution when the organisms are «balanced» with each other and their environment. This balance is achieved or «regulated» through various types of interactions, such as predation, parasitism, mutualism, commensalism, competition, and amensalism. Introduction of new elements, whether abiotic or biotic, into an ecosystem tend to have a disruptive effect. In some cases, this can lead to ecological collapse and the death of many native species. The branch of ecology that gave rise to this view has become known as systems ecology. Under this deterministic vision, the abstract notion of ecological health attempts to measure the robustness and recovery capacity for an ecosystem; that is, how far the ecosystem is away from steady state.

Ecosystems are often classified by reference to the biotopes concerned. The following ecosystems may be defined:

- continental ecosystems, such as forest ecosystems, meadow ecosystems such as steppes or savannas), or agro-ecosystems.
- ecosystems of inland waters, such as lentic ecosystems such as lakes or ponds; or lotic ecosystems such as rivers.
- oceanic ecosystems. Another classification can be done by reference to its communities, such as in the case of a human ecosystem.

Food web structure

The living portion of an ecosystem is best described in terms of feeding levels known as trophic levels. Green plants make up the first trophic level and are known as primary producers. Plants are able to convert energy from the sun into food in a process known as photosynthesis. In the second trophic level, the primary consumers – known as herbivores – are animals and insects that obtain their energy solely by eating the green plants. The third trophic level is composed of the secondary consumers, flesh-eating or carnivorous animals that feed on herbivores. At the fourth level are the tertiary consumers, carnivores that feed on other carnivores. Finally, the fifth trophic level consists of the decomposers, organisms such as fungi and bacteria that break down dead or dying matter into nutrients that can be used again.

Some or all of these trophic levels combine to form what is known as a food web, the ecosystem’s mechanism for circulating and recycling energy and materials. For example, in an aquatic ecosystem algae and other aquatic plants use sunlight to produce energy in the form of carbohydrates. Primary consumers such as insects and small fish may feed on some of this plant matter, and are in turn eaten by secondary consumers, such as salmon. A brown bear may play the role of the tertiary consumer by catching and eating salmon. Bacteria and fungi may then feed upon and decompose the salmon carcass left behind by the bear, enabling the valuable nonliving components of the ecosystem, such as chemical nutrients, to leach back into the soil and water, where they can be absorbed by the roots of plants. In this way nutrients and the energy that green plants derive from sunlight are efficiently transferred and recycled throughout the ecosystem.

A food web (or food cycle) is a natural interconnection of food chains and a graphical representation (usually an image) of what-eats-what in an ecological community. Another name for food web is consumer-resource system.

Food chain is transfer of food energy up the trophic levels from its source in plants and other autotrophic organisms (primary producers) through herbivores (primary consumers) to carnivores (secondary, tertiary, and quaternary consumers) to decomposers.

When energy moves between trophic levels, 10% of the energy is made available for the next level. (The exception is the transition from the sun to producers, in which case only 1% of the energy is retained). When a consumer eats a plant, it gains energy from the plant. That energy is used for growth, reproduction, and other biological processes. Some of that energy is also lost through heat loss. Thus, when a predator eats that consumer, all of the energy the consumer gained from the plant is not available to the predator: it has been used and lost. As we move up an energy pyramid or a trophic level, we can see that less and less of the original energy from the sun is available. Roughly ten percent of the previous trophic level's energy is available to the level immediately higher up. This is called the 10% Rule (fig. 7).

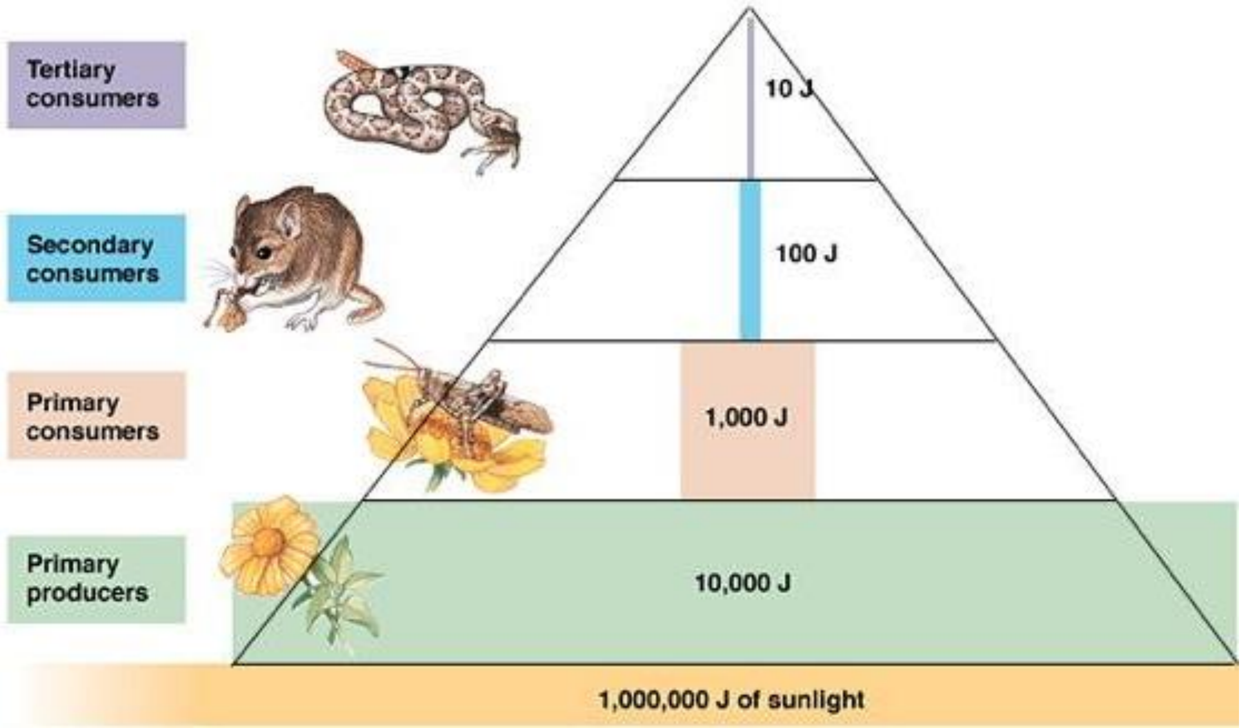

Figure 7 - The 10% Energy Rule in a Food Chain

Succession

Ecological succession, the process by which the structure of a biological community evolves over time. Two different types of succession — primary and secondary — have been distinguished. Primary succession occurs in essentially lifeless areas — regions in which the soil is incapable of sustaining life as a result of such factors as lava flows, newly formed sand dunes, or rocks left from a retreating glacier. Secondary succession occurs in areas where a community that previously existed has been removed; it is typified by smaller-scale disturbances that do not eliminate all life and nutrients from the environment.

Primary succession begins in barren areas, such as on bare rock exposed by a retreating glacier. The first inhabitants are lichens or plants — those that can survive in such environment. Over hundreds of years these “pioneer species” convert the rock into soil that can support simple plants such as grasses. These grasses further modify the soil, which is then colonized by other types of plants. Each successive stage modifies the habitat by altering the amount of shade and the composition of the soil. The final stage of succession is a climax community, which is a very stable stage that can endure for hundreds of years.

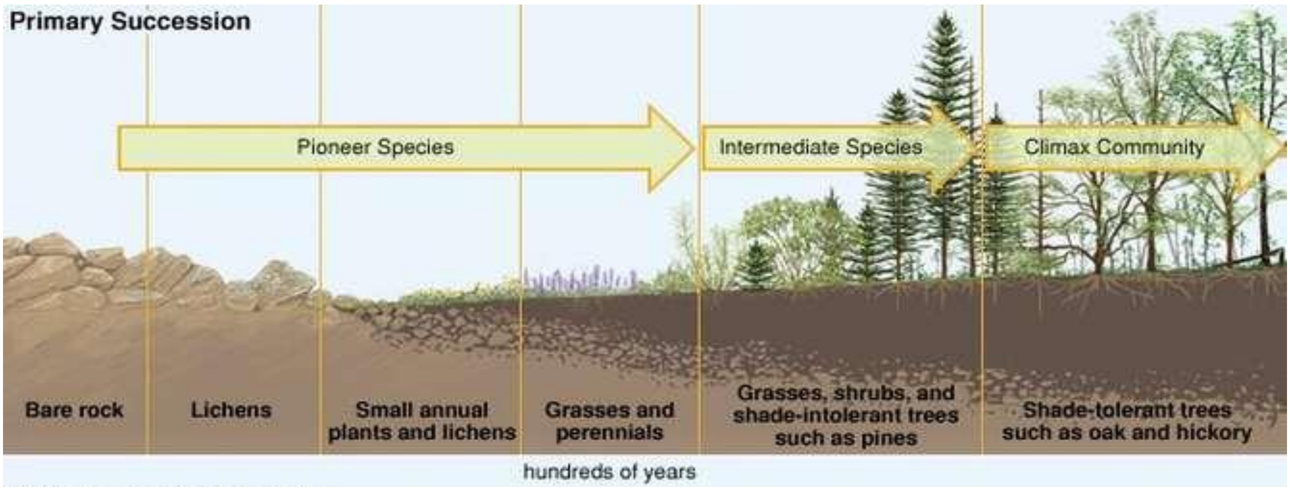

Figure 8 - Primary succession

Secondary succession follows a major disturbance, such as fire or flood. The stages of secondary succession are similar to those of primary succession; however, primary succession always begins on a barren surface, whereas secondary succession begins in environments that already possess soil. In addition, through a process called old-field succession, farmland that has been abandoned may undergo secondary succession.

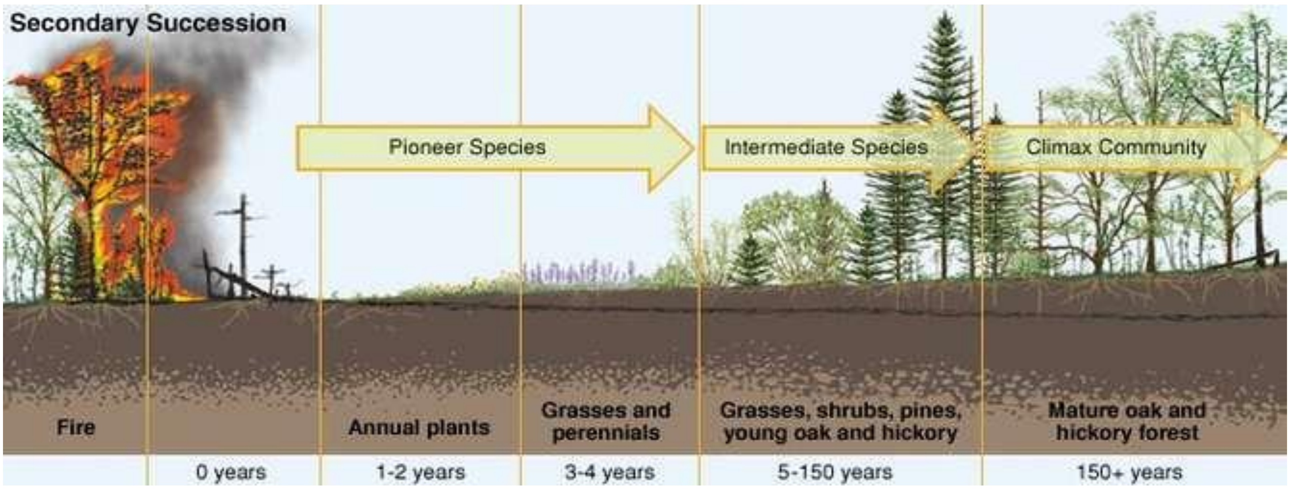

Figure 9 - Secondary succession

Agroecosystems

An agroecosystem can be viewed as a subset of a conventional ecosystem. As the name implies, at the core of an agroecosystem lies the human activity of agriculture. However, an agroecosystem is not restricted to the immediate site of agricultural activity (e.g. the farm), but rather includes the region that is impacted by this activity, usually by changes to the complexity of species assemblages and energy flows, as well as to the net nutrient balance. Traditionally an agroecosystem, particularly one managed intensively, is characterized as having a simpler species composition and simpler energy and nutrient flows than "natural" ecosystem.

Artificial ecosystems are terrestrial as well as aquatic. The terrestrial ones include rural and urban settlements, plantations, orchards, gardens, park, croplands and animal farms. The man-made aquatic ecosystems include dams, reservoirs, lakes, canals, fishery tanks, ponds and aquaria. The most important man-made ecosystems are croplands generally called agroecosystems.

The agroecosystems have many common features:

➢ They are created by man and are, thus, artificial.

➢ They are maintained and regulated by man.

➢ They lack the capacity of self-regulation.

➢ They are aerated, irrigated and fed with manure and synthetic fertilizers. The use of the latter causes water pollution.

➢ They are protected againsts pathogens and pests (insects, other animals and weeds) by the use of pesticides. The latter are toxic to the herbivorous animals and humans. They are fenced against the attack of cattle and other animals.

➢ They lack circulation of natural soil nutrients, hence need for artificial manuring.

- They lack stability because they are mostly monocultures and do not have diversity.
- They are prone to destruction by drought, floods, pests and diseases. Such destructions have caused famines in the past.
- Crops grown in agroecosystems are genetically improved to have higher yields.
- Machinery is used in sowing, spraying and reaping the crops.
- No biomass is left in the fields because of reaping.
- Stubbles are burnt to add ash to the fields. However, it causes air pollution.

The agroecosystems are created, regulated, fed, protected and improved by humans lack diversity, stability, circulation of nutrients, and self-regulation and leave no biomass in the fields because of reaping.

Answer these questions:

1. What are the main components of all ecosystems?
2. Can an ecological system be called a steady state? Why?
3. Decide whether these statements are true or false (T/F):

3.1 Components and processes of an ecosystem govern the behavior of some defined subset of the biosphere.

3.2 The ecosystem is composed of two entities, the entirety of life, the biotope and the medium that life exists in, the biocoenosis.

3.3 Energy from the sun is ultimately lost to the system as waste heat.

3.4 Decomposition is the first stage of biogeochemical cycles such as the carbon and nitrogen cycles.

3.5 The Convention on Biological Diversity was ratified by more than 75 countries.

3.6 The whole earth can be seen as a single ecosystem.

3.7 Predation, parasitism, mutualism, commensalism, competition, and amensalism are the elements, which cause a disruptive effect to an ecosystem.

4. What types of aquatic ecosystems do you know? Characterize briefly each one, pointing out the difference between them.
5. What do you know about autotrophic organisms and heterotrophic organisms?

Topic: Doctrine of biosphere
Goal: to study structure and evolution of the biosphere
Plan:
1. The concept of the Biosphere
2. The doctrine of the «Biosphere» by Vladimir Vernadsky
3. Geochemical cycle in the biosphere
4. The evolution of the biosphere

The concept of the Biosphere

Ecology can be studied at several levels: population level (individuals of the same species), biocoenosis level (or community of species), ecosystem level, and biosphere level.

The outer layer of the planet Earth can be divided into several compartments:

➢ The hydrosphere (or sphere of water). Water is essential for all living organisms on the Earth and has played a key role in the evolution and sustenance of life on our planet. The biosphere as we know it would not exist without liquid water (for example, consider Mars). Water is also important for transport the soluble nutrients (phosphate and nitrate) that are needed for plant growth, and for transporting the waste products of life's chemical reactions.

➢ The lithosphere (or sphere of soils and rocks) is the rigid, outermost shell of a terrestrial-type planet or natural satellite that is defined by its rigid mechanical properties. On Earth, it is composed of the crust and the portion of the upper mantle that behaves elastically on time scales of thousands of years or greater.

➢ The atmosphere (or sphere of the air). Life processes involve a vast number of chemical reactions some of which either extract or emit gases from and to the atmosphere. For example, photosynthesis consumes carbon dioxide and produces oxygen whereas respiration does the opposite. Other examples of biogenic gases in the atmosphere include methane, dimethylsulfide (DMS), nitrogen, nitrous oxide, ammonia, etc.).

The biosphere (or sphere of life), sometimes described as «the fourth envelope», is all living matter on the planet or that portion of the planet occupied by life. It reaches well into the other three spheres, although there are no permanent inhabitants of the atmosphere. Relative to the volume of the Earth, the biosphere is only the very thin surface layer which extends from 11,000 meters below sea level to 15,000 meters above.

The term «Biosphere» was formulated in 1875 by the Austrian geologist E. Suess. In his monograph "The Origin of the Alps", he speaks of an "independent biosphere" as a special shell of the Earth formed by living organisms. The biosphere is the life zone of the Earth and includes all living organisms, including man, and all organic matter that has not yet decomposed.

The doctrine of the «Biosphere» by Vladimir Vernadsky

The doctrine of the «Biosphere» was coined by Russian scientist Vladimir Vernadsky in the 1926. In Vernadsky's book "Biosfera", first published in 1926, in accordance with dialectic principle, the process of cosmogonic evolution of Earth is considered, in the light of dynamics of the environment, which includes the system of many different forms of matter turnover, while its highest form, the life, is determining other planetary processes. The latter being the very central idea in Vernadsky's teachings. Namely this concept served as a necessary and desired base for the development of modern ecology. The term "biosphere" is mentioned for the first time in the book's second sentence, but without any definition: «The face of the Earth viewed from celestial space presents a unique appearance, different from all other heavenly bodies. The surface that separates the planet from the cosmic medium is the biosphere, visible principally because of light from the sun, although it also receives an infinite number of other radiations from space, of which only a small fraction are visible to us» (Vernadsky 1998, p. 43).

Biosphere according to Vernadsky is a self-regulating system, including both living and non-living constituents. The work of living matter in the biosphere is manifested in two main forms: (a) chemical (biochemical) and (b) mechanical. Vernadsky made a detailed analysis of different forms of biochemical and mechanical transformations on environment activity of life and realized that there is no force on the face of the Earth more powerful in its results than the totality of living organisms. No phenomena in the biosphere are separated from life and biogeochemical cycles. To analyze these processes Vernadsky introduced the notions of "living matter" of the biosphere – the sum of its living organisms, "inert matter" – non-living substance and "bioinert matter", which is an organic composition of living organisms with not-living substance. The last concept is of special significance in the context of self-modification and indirect interactions in ecosystems. Soil is an example of bioinert matter. Many great living forms permeate soil and organize it. Biological activity of organisms constantly modifies this environment, and thus modifies organisms themselves, forming self-organized and self-modifying system. Vernadsky noticed that bioinert matter has unusual physical properties. However, indeed, soil being an open system demonstrates some properties of living tissue. Soil at the same time is an environment as well as an organic constituent part of the biosphere.

Vernadsky identified the boundaries of the biosphere as well as its composition, energetics, and dynamics. He included in the biosphere the upper part of the lithosphere to a depth of 2-3 km, which contains living bacteria, the hydrosphere, and the lower part of the atmosphere. Within the biosphere he distinguished two component types of matter: minerals, which he termed "inert," and living matter. The morphology of inert matter (its chemical composition and physical state) is preserved unchanged in the course of geological time, while living matter, both in totality and in its individual forms, undergoes continual change in the process of the biosphere's evolution as an integrated system.

The Vernadsky's biosphere includes:

- living matter – all living organisms;
- inanimate matter (inert or non-living matter). This is the set of those substances in the biosphere in the formation of which living organisms do not participate;
- biogeneric matter, that is, organic and mineral substances, created by living matter (for instance, coal, peat, litter, humus, etc.);
- bioinert matter, created by living organisms together with inorganic nature (water, atmosphere, sediment rocks).

Solar and chemical energy serve as the original source of the energy of life. The absorption of solar energy by photoautotrophs – the living matter that uniquely transforms solar energy into chemical energy and distributes it throughout the planet – is one of the most important functions of living matter in the biosphere. And this is the basic energy source for exogenous geochemical and geological processes. In other words, living matter, transforming solar radiation, draws inorganic material into continuous circulation. This idea is central to the concept of biogeochemistry, which Vernadsky introduced. He included the functions of the exchange of matter – respiration, alimentation, creation of the body mass of organisms, their movements and the work they perform, and even grander undertakings on the scale of human communities. Biogenic migration is of extraordinary importance in the structure of the biosphere.

The main functions of living matter are the following: 1) energy; 2) destructive; 3) concentration, and 4) environment-forming.

The essence of the first of these is to absorb solar energy during photosynthesis and energy transfer through the food chain. For own needs of the body is spent on average 10-12% of assimilated energy. The rest of it is redistributed within the ecosystem. Energy is partially dissipated and partly accumulates in nutrients. After moving to the state of fossil energy is preserved in the earth's crust and is the power base for the geological processes that provide the energy needs of humanity.

Destructive function of living matter is the decomposition and mineralization of dead material in the chemical decomposition of rocks, minerals formed involvement in biotic circulation. A special group of organisms (decomposers) destructors decompose dead organic matter to simple inorganic compounds: carbon dioxide, water, hydrogen sulfide, methane, ammonia, which is then re-used in the initial link of the cycle.

Concentration function is manifested in the selective accumulation in the vital activity of the atoms of substances dispersed in nature. The most active hubs of many elements are organisms.

Finally, the environmental function of living matter is to transform the physical and chemical parameters of the environment (lithosphere, hydrosphere, and atmosphere) in conditions favorable to the existence of organisms. With a certain degree of conditionality, it can be argued that this function is the result of the combined action of all the above functions of living matter. As a result, it is habitat functions formed sedimentary cover has been converted gas composition of the atmosphere has changed the chemical composition of the primary waters of the ocean, there was a soil cover on the land surface.

Life evolved on earth during its early history between 4,5 and 3,8 billion years ago and the biosphere readily distinguishes our planet from all others in the solar system. The chemical reactions of life (e.g., photosynthesis-respiration, carbonate precipitation, etc.) have also imparted a strong signal on the chemical composition of the atmosphere, transforming the atmosphere from reducing conditions to and oxidizing environment with free oxygen. The biosphere is structured into a hierarchy known as the food chain whereby all life is dependent upon the first tier (i.e. mainly the primary producers that are capable of photosynthesis).

Plants take carbon dioxide out of the atmosphere for photosynthesis, but respiration and burning put carbon dioxide back. So does the decay of dead organic matter. During the carboniferous period (over 300 million years ago) large amounts of carbon accumulated as coal, peat, oils and natural gas. These are fossil fuels. It took millions of years to make these fuels, but we are burning them all up in a few hundred years.

Geochemical cycles in the Biosphere

According to Vernadsky, life is the geological force. Indeed all geological features at Earth’s surface are bio-influenced. The planetary influence of living matter becomes more extensive with time. The number and rate of chemical elements transformed and the spectrum of chemical reactions engendered by living matter are increasing, so that more parts of Earth are incorporated into the biosphere.

Biogeochemical cycle, any of the natural pathways by which essential elements of living matter are circulated. The term biogeochemical is a contraction that refers to the consideration of the biological, geological, and chemical aspects of each cycle.

Elements within biogeochemical cycles flow in various forms from the nonliving (abiotic) components of the biosphere to the living (biotic) components and back. In order for the living components of a major ecosystem (e.g., a lake or a forest) to survive, all the chemical elements that make up living cells must be recycled continuously. Each biogeochemical cycle can be considered as having a reservoir (nutrient) pool — a larger, slow-moving, usually abiotic portion—and an exchange (cycling) pool—a smaller but more active portion concerned with the rapid exchange between the biotic and abiotic aspects of an ecosystem.

Biogeochemical cycles can be classed as gaseous, in which the reservoir is the air or the oceans (via evaporation), and sedimentary, in which the reservoir is Earth's crust.

Gaseous cycles include those of nitrogen, oxygen, carbon, and water; sedimentary cycles include those of iron, calcium, phosphorus, sulfur, and other more-earthbound elements.

Nitrogen cycle. Nitrogen, a component of proteins and nucleic acids, is essential to life on Earth. Although 78 percent by volume of the atmosphere is nitrogen gas, this abundant reservoir exists in a form unusable by most organisms. Through a series of microbial transformations, however, nitrogen is made available to plants, which in turn ultimately sustain all animal life. The steps, which are not altogether sequential, fall into the following classifications: nitrogen fixation, nitrogen assimilation, ammonification, nitrification, and denitrification.

- Nitrogen fixation, in which nitrogen gas is converted into inorganic nitrogen compounds, is mostly (90 percent) accomplished by certain bacteria and blue-green algae. A much smaller amount of free nitrogen is fixed by abiotic means (e.g., lightning, ultraviolet radiation, electrical equipment) and by conversion to ammonia through the Haber-Bosch process.
- Nitrates and ammonia resulting from nitrogen fixation are assimilated into the specific tissue compounds of algae and higher plants. Animals then ingest these algae and plants, converting them into their own body compounds.
- The remains of all living things – and their waste products – are decomposed by microorganisms in the process of ammonification, which yields ammonia (NH3) and ammonium (NH4+). (Under anaerobic, or oxygen-free, conditions, foul-smelling putrefactive products may appear, but they too are converted to ammonia in time.) Ammonia can leave the soil or be converted into other nitrogen compounds, depending in part on soil conditions.
- Nitrification, a process carried out by nitrifying bacteria, transforms soil ammonia into nitrates (NO_3^-), which plants can incorporate into their own tissues.
- Nitrates also are metabolized by denitrifying bacteria, which are especially active in water-logged anaerobic soils. The action of these bacteria tends to deplete soil nitrates, forming free atmospheric nitrogen.

Oxygen cycle. Free in the air and dissolved in water, oxygen is second only to nitrogen in abundance among uncombined elements in the atmosphere. Plants and animals use oxygen to respire and return it to the air and water as carbon dioxide (CO_2). CO_2 is then taken up by algae and terrestrial green plants and converted into carbohydrates during the process of photosynthesis, oxygen being a by-product. The waters of the world are the main oxygen generators of the biosphere; their algae are estimated to replace about 90 percent of all oxygen used. Oxygen is involved to some degree in all the other biogeochemical cycles. For example, over time, detritus from living organisms transfers oxygen-containing compounds such as calcium carbonates into the lithosphere.

Carbon cycle. Carbon is a constituent of all organic compounds, many of which are essential to life on Earth. The source of the carbon found in living matter is carbon dioxide (CO_2) in the air or dissolved in water. Algae and terrestrial green plants (producers) are the chief agents of carbon dioxide fixation through the process of photosynthesis, through which carbon dioxide and water are converted into simple carbohydrates. These compounds are used by the producers to carry on metabolism, the excess being stored as fats and polysaccharides. The stored products are then eaten by consumer organisms, from protozoans to man, which convert them into other forms. CO2 is added directly to the atmosphere by animals and some other organisms as a by-product of respiration. The carbon present in animal wastes and in the bodies of all organisms is released as CO_2 by decay, or decomposer, organisms (chiefly bacteria and fungi) in a series of microbial transformations.

Part of the organic carbon — the remains of organisms — has accumulated in Earth's crust as fossil fuels (e.g., coal, gas, and petroleum), limestone, and coral. The carbon of fossil fuels, removed from the cycle in prehistoric time, is now being released in vast amounts as CO2 through industrial and agricultural processes, much of it quickly passing into the oceans and there being "fixed" as carbonates. If oxygen is scarce (as in sewage, marshes, and swamps), some carbon is released as methane gas.

Water cycle, also called hydrologic cycle, is the cycle that involves the continuous circulation of water in the Earth-atmosphere system. Of the many processes involved in the water cycle, the most important are evaporation, transpiration, condensation, precipitation, and runoff. Although the total amount of water within the cycle remains essentially constant, its distribution among the various processes is continually changing.

Evaporation, one of the major processes in the cycle, is the transfer of water from the surface of the Earth to the atmosphere. By evaporation, water in the liquid state is transferred to the gaseous, or vapour, state. This transfer occurs when some molecules in water mass have attained sufficient kinetic energy to eject themselves from the water surface.

The main factors affecting evaporation are temperature, humidity, wind speed, and solar radiation. The direct measurement of evaporation, though desirable, is difficult and possible only at point locations. The principal source of water vapour is the oceans, but evaporation also occurs in soils, snow, and ice.

Evaporation from snow and ice, the direct conversion from solid to vapour, is known as sublimation. Transpiration is the evaporation of water through minute pores, or stomata, in the leaves of plants. For practical purposes, transpiration and the evaporation from all water, soils, snow, ice, vegetation, and other surfaces are lumped together and called evapotranspiration, or total evaporation.

Water vapour is the primary form of atmospheric moisture. Although its storage in the atmosphere is comparatively small, water vapour is extremely important in forming the moisture supply for dew, frost, fog, clouds, and precipitation. Practically all water vapour in the atmosphere is confined to the troposphere (the region below 6 to 8 miles (10 to 13 km) altitude).

The transition process from the vapour state to the liquid state is called condensation. Condensation may take place as soon as the air contains more water vapour than it can receive from a free water surface through evaporation at the prevailing temperature. This condition occurs as the consequence of either cooling or the mixing of air masses of different temperatures. By means of condensation, water vapour in the atmosphere is released to form precipitation.

Precipitation that falls to the Earth is distributed in four main ways: some is returned to the atmosphere by evaporation, some may be intercepted by vegetation and then evaporated from the surface of leaves, some percolates into the soil by infiltration, and the remainder flows directly as surface runoff into the sea. Some of the infiltrated precipitation may later percolate into streams as groundwater runoff. Direct measurement of runoff is made by stream gauges and plotted against time on hydrographs.

Most groundwater is derived from precipitation that has percolated through the soil. Groundwater flow rates, compared with those of surface water, are very slow and variable, ranging from a few millimetres to a few metres a day. Groundwater movement is studied by tracer techniques and remote sensing.

Ice also plays role in the water cycle. Ice and snow on the Earth's surface occur in various forms such as frost, sea ice, and glacier ice. When soil moisture freezes, ice also occurs beneath the Earth's surface, forming permafrost in tundra climates. About 18,000 years ago glaciers and ice caps covered approximately one-third of the Earth's land surface.

The evolution of the biosphere

The process of the origin and evolution of living organisms is indivisible from the process of the origin and evolution of biosphere, the global planetary system. The origin of earthly life and the origin of the biosphere are aspects of a whole indivisible process. Since the evolution of the biosphere is closely related to the evolution of other geospheres of planet Earth, it is advisable to consider this issue in the aspect of geochronology of the Earth.

Earth's surface is a complex mosaic of exposures of different rock types that are assembled in an astonishing array of geometries and sequences. Individual rocks in the myriad of rock outcroppings (or in some instances shallow subsurface occurrences) contain certain materials or mineralogical information that can provide insight as to their “age.”

For years investigators determined the relative ages of sedimentary rock strata on the basis of their positions in an outcrop and their fossil content. According to the long-standing principle of the geosciences, that of superposition, the oldest layer within a sequence of strata is at the base and the layers are progressively younger with ascending order. The relative ages of the rock strata deduced in this manner can be corroborated and at times refined by the examination of the fossil forms present. The tracing and matching of the fossil content of separate rock outcrops (i.e., correlation) eventually enabled investigators to integrate rock sequences in many areas of the world and construct a relative geologic time scale.

Some estimates suggest that as much as 70 percent of all rocks out-cropping from the Earth’s surface are sedimentary. Preserved in these rocks is the complex record of the many transgressions and regressions of the sea, as well as the fossil remains or other indications of now extinct organisms and the petrified sands and gravels of ancient beaches, sand dunes, and rivers.

The geologic time scale is the “calendar” for events in Earth history. It subdivides all time into named units of abstract time called – in descending order of duration – eons, eras, periods, epochs, and ages. The enumeration of those geologic time units is based on stratigraphy, which is the correlation and classification of rock strata. The fossil forms that occur in the rocks provide the chief means of establishing a geologic time scale. One of the most widely used standard charts showing the relationships between the various intervals of geologic time is the International Chronostratigraphic Chart, which is maintained by the International Commission on Stratigraphy (ICS).

Because living things have undergone evolutionary changes over geologic time, particular kinds of organisms are characteristic of particular parts of the geologic record. By correlating the strata in which certain types of fossils are found, the geologic history of various regions – and of Earth as a whole – can be reconstructed. The relative geologic time scale developed from the fossil record has been numerically quantified by means of absolute dates obtained with radiometric dating methods.

1. The Precambrian is the earliest part of Earth's history, set before the current Phanerozoic Eon. The Precambrian is a supereon that is subdivided into three eons (Hadean, Archean, Proterozoic) of the geologic time scale.

1.1 Hadean began with the formation of the Earth about 4.6 billion years ago and ended, as defined by the ICS, 4 billion years ago.

1.2 Archean is one of the four geologic eons of Earth history, occurring 4,000 to 2,500 million years ago (4 to 2.5 billion years ago). There are four eras in the Archean: Eoarchean, Paleoarchean, Mesoarchean, Neoarchean. The Archean atmosphere to have nearly lacked free oxygen. Life in the Archean was limited to simple single-celled organisms (lacking nuclei), called Prokaryota. The first life forms and self-replicating RNA molecules evolve around 4,000 Ma, after the Late Heavy Bombardment ends on Earth. Simple single-celled life (probably bacteria and archaea). First known oxygen-producing bacteria. First stromatolites (probably colonial cyanobacteria).

1.3 Proterozoic is a geological eon representing the time just before the proliferation of complex life on Earth. The Proterozoic Eon extended from 2500 Ma to 541 Ma (million years ago), and is the most recent part of the Precambrian Supereon. It can be also described as the time range between the appearance of oxygen in Earth's atmosphere and the appearance of first complex life forms (like trilobites or corals). It is subdivided into three geologic eras (from oldest to youngest): the Paleoproterozoic, Mesoproterozoic, and Neoproterozoic. The first advanced single-celled, eukaryotes and multi-cellular life, Francevillian Group Fossils, roughly coincides with the start of the accumulation of free oxygen. This may have been due to an increase in the oxidized nitrates that eukaryotes use, as opposed to cyanobacteria. It was also during the Proterozoic that the first symbiotic relationships between mitochondria (found in nearly all eukaryotes) and chloroplasts (found in plants and some protists only) and their hosts evolved. The blossoming of eukaryotes such as acritarchs did not preclude the expansion of cyanobacteria; in fact, stromatolites reached their greatest abundance and diversity during the Proterozoic, peaking roughly 1200 million years ago.

2. The Phanerozoic Eon is the current geologic eon in the geologic time scale, and the one during which abundant animal and plant life has existed. It covers 541 million years to the present, and began with the Cambrian Period when diverse hard-shelled animals first appeared. The Phanerozoic is divided into three eras: the Paleozoic, Mesozoic, and Cenozoic, which are further subdivided into 12 periods.

2.1 The Paleozoic (or Palaeozoic) Era is the earliest of three geologic eras of the Phanerozoic Eon. It is the longest of the Phanerozoic eras, lasting from 541 to 251.902 million years ago, and is subdivided into six geologic periods (from oldest to youngest): the Cambrian, Ordovician, Silurian, Devonian, Carboniferous, and Permian. The Paleozoic was a time of dramatic geological, climatic, and evolutionary change. During the early Paleozoic, the huge continent Gondwana (510 million years ago) formed or was forming. By mid-Paleozoic, the collision of North America and Europe produced the Acadian-Caledonian uplifts, and a subduction plate uplifted eastern Australia. By the late Paleozoic, continental collisions formed the supercontinent of Pangaea and resulted in some of the great mountain chains, including the Appalachians, Ural Mountains, and mountains of Tasmania. The Cambrian witnessed the most rapid and widespread diversification of life in Earth's history, known as the Cambrian explosion, in which most modern phyla first appeared. Fish, arthropods, amphibians, anapsids, synapsids, euryapsids, and diapsids all evolved during the Paleozoic. Life began in the ocean but eventually transitioned onto land, and by the late Paleozoic, it was dominated by various forms of organisms. Great forests of primitive plants covered the continents, many of which formed the coal beds of Europe and eastern North America. Towards the end of the era, large, sophisticated diapsids and synapsids were dominant and the first modern plants (conifers) appeared. The Paleozoic Era ended with the largest extinction event in the history of Earth, the Permian–Triassic extinction event. The effects of this catastrophe were so devastating that it took life on land 30 million years into the Mesozoic Era to recover. Recovery of life in the sea may have been much faster.

2.2 The Mesozoic Era is an interval of geological time from about 252 to 66 million years ago. This Era is also called the Age of Reptiles and the Age of Conifers. The era is subdivided into three major periods: the Triassic, Jurassic, and Cretaceous, which are further subdivided into a number of epochs and stages.

The era began in the wake of the Permian-Triassic extinction event, the largest well-documented mass extinction in Earth's history, and ended with the Cretaceous-Paleogene extinction event, another mass extinction which is known for having killed off non-avian dinosaurs, as well as other plant and animal species. The Mesozoic was the time of significant tectonic, climate and evolutionary activity. The era witnessed the gradual rifting of the super-continent Pangaea into separate landmasses that would eventually move into their current positions. The climate of the Mesozoic was varied, alternating between warming and cooling periods. Overall, however, the Earth was hotter than it is today. Dinosaurs appeared in the Late Triassic and became the dominant terrestrial vertebrates early in the Jurassic, occupying this position for about 135 million years until their demise at the end of the Cretaceous. Birds first appeared in the Jurassic, having evolved from a branch of theropod dinosaurs. The first mammals also appeared during the Mesozoic, but would remain small – less than 15 kg (33 lb) – until the Cenozoic.

2.3 The Cenozoic Era is the current geological era, covering the period from 66 million years ago to the present day. The Cenozoic is also known as the Age of Mammals, because of the large mammals that dominate it. The continents also moved into their current positions during this era. The Cenozoic is divided into three periods: the Paleogene, Neogene, and Quaternary; and seven epochs: the Paleocene, Eocene, Oligocene, Miocene, Pliocene, Pleistocene, and Holocene. Early in the Cenozoic the planet was dominated by relatively small fauna, including small mammals, birds, reptiles, and amphibians.

From a geological perspective, it did not take long for mammals and birds to greatly diversify in the absence of the dinosaurs that had dominated during the Mesozoic. Mammals came to occupy almost every available niche (both marine and terrestrial), and some also grew very large, attaining sizes not seen in most of today's terrestrial mammals. Early animals were the Entelodon (the so-called "hell pig"), Paraceratherium (a hornless rhinoceros relative) and Basilosaurus (an early whale). The extinction of many large diapsid groups, such as flightless dinosaurs, Plesiosauria and Pterosauria allowed mammals and birds to greatly diversify and become the world's predominant fauna. During the Cenozoic, mammals proliferated from a few small, simple, generalized forms into a diverse collection of terrestrial, marine, and flying animals, giving this period its other name, the Age of Mammals, despite the fact that there are more than twice as many bird species as mammal species.

The Cenozoic is just as much the age of savannas, the age of co-dependent flowering plants and insects, and the age of birds. Grass also played a very important role in this era, shaping the evolution of the birds and mammals that fed on it. One group that diversified significantly in the Cenozoic as well was the snakes.

Evolving in the Cenozoic, the variety of snakes increased tremendously, resulting in many colubrids, following the evolution of their current primary prey source, the rodents.

The Cenozoic is full of mammals including chalicotheres, creodonts, whales, primates, entelodonts, saber-toothed cats, mastodons and mammoths, three-toed horses, giant rhinoceros like Indricotherium, the rhinoceros-like brontotheres, various bizarre groups of mammals from South America, such as the vaguely elephant-like pyrotheres and the dog-like marsupial relatives called borhyaenids and the monotremes and marsupials of Australia.

Many animals evolved including mammoths, giant ground sloths, dire wolves, saber-toothed cats, and most famously Homo sapiens. 100,000 years ago marked the end of one of the worst droughts in Africa, and led to the expansion of primitive humans. As the Pleistocene drew to close, major extinction wiped out much of the world's megafauna, including some of the hominid species, such as Neanderthals.

All recorded history and "the history of the world" lies within the boundaries of the Holocene epoch. Human activity is blamed for mass extinction that began roughly 10,000 years ago, though the species becoming extinct have only been recorded since the Industrial Revolution. This is sometimes referred to as the "Sixth Extinction". Over 322 species have become extinct due to human activity since the Industrial Revolution.

Answer these questions:

1. Why is the biosphere described sometimes as «the fourth envelope»?
2. Where did life first develop? How?
3. What elements does the biosphere contain?
4. How important are the oceans for water cycling?
5. Decide whether these statements are true or false (T/F):

   5.1 The biosphere is sphere of soils and rocks.

   5.2 The ozone layer protects living beings from UV rays.

   5.3 The deep ocean vent communities need sunlight for utilizing the chemistry of the hot volcanic vents.

   5.4 At the ecosystem and biosphere levels, there is a continual recycling of carbon, nitrogen, oxygen and other elements, such as phosphorus, calcium, and potassium.

5.5 The process of photosynthesis releases carbon.

5.6 Glucose and other sugar molecules are concentrated in nectar and entice pollinators to aid plants in reproduction.

5.7 Water and carbon dioxide are the two constituents which cause the process of cellular respiration.

Topic: Doctrine of life safety

Goal: to develop understanding of the basic principles of life safety; to study the classification of hazards; to consider the basics of healthy lifestyle.

Plan:

1. The place and role of knowledge of life safety basics in the modern world
2. Conceptual issues and principles of safety
3. Fundamentals of human interaction with the environment
4. Dangers, their classification
5. Fundamentals of healthy lifestyle

The place and role of knowledge of life safety basics in the modern world

Scientists and biologists believe that the human life expectancy is 130 - 150 years. In fact it is proved in the case of long-livers. The real life expectancy depends on many factors that determine the conditions of human life.

Life expectancy has increased rapidly since the Enlightenment. Estimates suggest that in a pre-modern, poor world, life expectancy was around 30 years in all regions of the world. In the early 19th century, life expectancy started to increase in the early industrialized countries while it stayed low in the rest of the world. This led to a very high inequality in how health was distributed across the world. Good health in the rich countries and persistently bad health in those countries that remained poor. Over the last decades this global inequality decreased. Countries that not long ago were suffering from bad health are catching up rapidly. Since 1900 the global average life expectancy has more than doubled and is now approaching 70 years (tab. 2).

Table 2

Life expectancy in different countries

Rating	**Country**	**Life Expectancy (years)**
1	Hong Kong	84.0
2	Japan	83.5
3	Italy	83.1
4	Singapore	83.0
5	Switzerland	83.0
10	France	82.2
116	Russia	70.1
123	Kazakhstan	69.4
190	Swaziland	49.0

Life expectancy is responsive to changing living conditions. Life conditions, people lifestyle are directly connected with life safety. Annually in extreme situations hundreds of thousands of people die directly and millions of people indirectly. All the reasons of this category are directly related to this course.

It is unlikely that ever one will be able to exclude extreme situations (at least natural disasters) and due to them death of people. Thus reducing the number of people who die because of ignorance, inability or unpreparedness is the main objective of the course "Life safety basics".

Conceptual issues and principles of safety

The central figure of the knowledge system that defines the concept "life safety" is man. In this sense, man is viewed as a phenomenon, a generalized concept. However, a person has his own character, features, habits, individual gene apparatus, health status, norms of behavior, etc. Consequently, the notions of person's worth, his health and healthy lifestyle should be included in the scope of life safety concepts.

Man exists under certain conditions that could have direct or indirect, instantaneous or time remote impact both on the activity of man and the products of this activity, and directly on his health and his offspring. That is, man exists in a certain habitat. One of the components of the environment is nature. The relationship between man and nature is very complex. On the one hand, nature creates conditions for man to live - it provides air, water, food, protection from external influences, and on the other hand, because of violent nature forces it destroys products of his activity, threatens, disables or even kill. But man was able to influence nature, not only for his good, but also for great harm. Thus, one of the aspects of human life is realized in the system "man - nature".

Man interacts with other people. Therefore there are social relationships potentially threatening the existence of man that are expressed in the complex system "man - society - nature."

Strong desire for self-development, knowledge, improvement of living conditions, expansion of one's own capabilities in all areas of human activity led to the emergence of sciences, technology, new substances and materials unknown to nature, technologies, industries, which in turn increased both the number and quality of threats towards man. Now the whole variety of conditions for safe living can be included into the system "man - society - nature - technogenic sphere".

So the system of scientific knowledge related to life safety is based on "man - environment" relationships. These relationships are realized in the form of hazards, their forecasting, avoidance, overcoming and elimination of consequences. Therefore, another key concept of life safety is danger.

Dangers, their classification

According to origin there can be distinguished natural, technogenic, anthropogenic, ecological, social (including military, criminogenic) dangers.

Dangers are also primary and secondary. The primary danger is directly related to the threatening factor, the secondary one is the result of it, and it is important to note that the consequences of secondary dangers often outweigh the results of the primary ones. For example, fires, often caused by explosions, represent secondary danger.

By the nature of the effect directly on human body there can be identified mechanical, physical, chemical, biological, psycho-physiological dangers.

Dangers can cause different consequences:

- Harm to person - discomfort, fatigue, disease, trauma, death;
- Damage - social, technical, environmental, economic, intellectual.

Spheres of dangers: domestic, sports, socio-cultural, scientific, industrial, transport, military, etc.

Taking into account all available scientific and practical experience in the field of human safety, humanity has realized that any human activity is potentially dangerous. That is, it is impossible to achieve absolute safety in any type of activity.

Fundamentals of healthy lifestyle

Health is not merely the absence of disease or infirmity, but rather a state of complete physical, mental and social well-being.

Of the 56.4 million deaths worldwide in 2015, more than half (54%) were due to the top 10 causes. Ischemic heart disease and stroke are the world’s biggest killers, accounting for a combined 15 million deaths in 2015. These diseases have remained the leading causes of death globally in the last 15 years.

Chronic obstructive pulmonary disease claimed 3.2 million lives in 2015, while lung cancer (along with trachea and bronchus cancers) caused 1.7 million deaths. Diabetes killed 1.6 million people in 2015, up from less than 1 million in 2000. Deaths due to dementias more than doubled between 2000 and 2015, making it the 7th leading cause of global deaths in 2015.

Lower respiratory infections remained the most deadly communicable disease, causing 3.2 million deaths worldwide in 2015. The death rate from diarrhoeal diseases almost halved between 2000 and 2015, but still caused 1.4 million deaths in 2015. Similarly, tuberculosis killed fewer people during the same period, but is still among the top 10 causes with a death toll of 1.4 million. HIV/AIDS is no longer among the world’s top 10 causes of death, having killed 1.1 million people in 2015 compared with 1.5 million in 2000.

Road injuries killed 1.3 million people in 2015, about three-quarters (76%) of whom were men and boys.

Respiratory diseases prevail in the structure of students` sick rate. This is due to the influence of exo - and endogenous factors: tobacco smoking, atopic and infectious allergens, frequent ARVI (acute respiratory viral infection), ecological condition of region, burdened heredity.

Eye diseases are in second place due to increased visual load during training period, lack of adequate rest for students, lack of sleep, disregard for eye gymnastics, and also heredity.

In third place are diseases of the digestive system, which is due to inadequate food intake, absence of breakfast, food habits of modern youth, poor diet.

Diseases of the musculoskeletal system, mainly deforming dorsopathies, are in fourth place. This is mostly due to the acquired pathology in school and the way of life of students during the period of study.

In fifth place come endocrine system diseases, eating disorders and metabolic disorders due to thyroid diseases.

All the ailments of person can be divided into two large groups - infectious and noncommunicable diseases.

The success of medicine in the development of preventive measures for mass infections - the creation of vaccines and serums, effective medicines, training of population for prevention of infections and development of the system of measures aimed at eliminating the foci of infection and its pathogens have significantly reduced the death rate of the population from infectious diseases.

Noncommunicable diseases (NCDs), also known as chronic diseases, tend to be of long duration and are the result of the combination of genetic, physiological, environmental and behaviours factors.

The main types of NCDs are cardiovascular diseases (like heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma) and diabetes.

NCDs disproportionately affect people in low- and middle-income countries where more than three quarters of global NCD deaths – 31 million – occur.

Key facts of noncommunicable diseases:

- Noncommunicable diseases (NCDs) kill 40 million people each year, equivalent to 70% of all deaths globally.
- Each year, 15 million people die from a NCD between the ages of 30 and 69 years; over 80% of these "premature" deaths occur in low- and middle-income countries.
- Cardiovascular diseases account for most NCD deaths, or 17.7 million people annually, followed by cancers (8.8 million), respiratory diseases (3.9million), and diabetes (1.6 million).
- These 4 groups of diseases account for over 80% of all premature NCD deaths.

- ➢ Tobacco use, physical inactivity, the harmful use of alcohol and unhealthy diets all increase the risk of dying from a NCD.
- ➢ Detection, screening and treatment of NCDs, as well as palliative care, are key components of the response to NCDs.

People of all age groups, regions and countries are affected by NCDs. These conditions are often associated with older age groups, but evidence shows that 15 million of all deaths attributed to NCDs occur between the ages of 30 and 69 years. Of these "premature" deaths, over 80% are estimated to occur in low- and middle-income countries. Children, adults and the elderly are all vulnerable to the risk factors contributing to NCDs, whether from unhealthy diets, physical inactivity, exposure to tobacco smoke or the harmful use of alcohol.

These diseases are driven by forces that include rapid unplanned urbanization, globalization of unhealthy lifestyles and population ageing. Unhealthy diets and a lack of physical activity may show up in people as raised blood pressure, increased blood glucose, elevated blood lipids and obesity. These are called metabolic risk factors that can lead to cardiovascular disease, the leading NCD in terms of premature deaths.

The most careful attention should be given to the conditions for emergence and development of non-communicable diseases. Our lifestyle is the main factor of our health or illness. We and our healthy lifestyle (or deviations from it) determine our existence and well-being.

The components of healthy lifestyle are:

1. Refusal from harmful addictions, and first of all, from smoking, drinking alcohol and drugs.
2. Regular physical activity. Lack of physical activity is a significant risk factor for noncommunicable diseases (NCDs) such as stroke, diabetes, and cancer. Less and less physical activity is occurring in many countries. Globally, 23% of adults and 81% school-going adolescents are not active enough.

<u>Physical activity reduces the risk of disease.</u> Physical activity reduces the risk of coronary heart disease and stroke, diabetes, hypertension, various types of cancer including colon cancer and breast cancer, as well as depression. Physical activity is also fundamental to energy balance and weight control. Globally, about 23% of adults and 81% of school-going adolescents are not active enough. Generally, women and girls are less active than men and boys, and older adults are less active than younger adults.

<u>Regular physical activity helps to maintain healthy body</u>. People who are physically active:

- ➢ improve their muscular and cardio-respiratory fitness;
- ➢ improve their bone and functional health;
- ➢ have lower rates of coronary heart disease, high blood pressure, stroke, diabetes, cancer (including colon and breast cancer), and depression;

- ➢ have a lower risk of falling and of hip or vertebral fractures; and
- ➢ are more likely to maintain their weight.

Physical activity is not the same as sport. Physical activity is any bodily movement produced by the skeletal muscles that uses energy. This includes sports, exercise, and other activities such as playing, walking, household chores, gardening, and dancing. Any activity, be it for work, to walk or cycle to and from places, or as part of leisure time, has a health benefit.

Moderate and vigorous physical activity bring benefits. Intensity refers to the rate at which the activity is being performed. It can be thought of as how hard a person works to do an activity. The intensity of different forms of physical activity varies between people. Depending on an individual's relative level of fitness, examples of moderate physical activity could include: brisk walking, dancing, or household chores. Examples of vigorous physical activity could be: running, fast cycling, fast swimming, or moving heavy loads.

60 minutes a day for people 5-17 years old. People aged 5-17 should have at least 60 minutes of moderate to vigorous physical activity daily. More than 60 minutes of physical activity a day brings additional health benefits.

150 minutes a week for people 18-64 years old. Adults aged 18–64 should do at least 150 minutes of moderately intense physical activity each week, or at least 75 minutes of vigorous activity throughout the week, or an equivalent combination of moderate and vigorous activity. In order to be beneficial for cardio-respiratory health, all activity should be performed in bouts of at least 10 minutes duration.

Adults aged 65 and above. The main recommendations for adults and older adults are the same. In addition, older adults with poor mobility should do physical activity to enhance balance and prevent falls 3 or more days per week. When older adults cannot do the recommended amount of physical activity due to health conditions, they should be as physically active as their abilities and conditions allow.

All healthy adults need to be physically active. Unless specific medical conditions indicate the contrary, WHO's recommendations apply to all people – irrespective of gender, race, ethnicity, or income level. These recommendations also apply to individuals with chronic noncommunicable conditions, not related to mobility, such as hypertension or diabetes. Adults with disabilities should also follow WHO's recommendations.

Some physical activity is better than none. Inactive people should start with small amounts of physical activity and gradually increase duration, frequency, and intensity over time. Inactive adults, older adults, and those with disease limitations will have added health benefits when they become more active. Pregnant women, postpartum women, and persons with cardiac conditions may need to take extra precautions and seek medical advice before striving to achieve the recommended levels of physical activity.

Supportive environments and communities help people to be physically active. Urban and environmental policies have huge potential to increase levels of physical activity . These policies should ensure that:

- walking, cycling and other forms of active transportation are accessible and safe for all;
- labour and workplace policies encourage physical activity;
- schools have safe spaces and facilities for students to spend their free time actively; and
- sports and recreation facilities provide opportunities for everyone to be physically active.

3. Acclimation, which increases body's resistance to diseases and adverse effects of environment.

4. Healthy diet, balanced by a set of vital substances (proteins, fats, carbohydrates, vitamins, microelements). A healthy diet helps protect against malnutrition in all its forms, as well as noncommunicable diseases (NCDs), including diabetes, heart disease, stroke and cancer. Energy intake (calories) should be in balance with energy expenditure. Evidence indicates that total fat should not exceed 30% of total energy intake to avoid unhealthy weight gain. Limiting intake of free sugars to less than 10% of total energy intake is part of a healthy diet. A further reduction to less than 5% of total energy intake is suggested for additional health benefits.

Keeping salt intake to less than 5 g per day helps prevent hypertension and reduces the risk of heart disease and stroke in the adult population.

WHO Member States have agreed to reduce the global population’s intake of salt by 30% and halt the rise in diabetes and obesity in adults and adolescents as well as in childhood overweight by 2025.

The exact make-up of a diversified, balanced and healthy diet will vary depending on individual needs (e.g. age, gender, lifestyle, degree of physical activity), cultural context, locally available foods and dietary customs. But basic principles of what constitute a healthy diet remain the same.

For adults a healthy diet contains:

- Fruits, vegetables, legumes (e.g. lentils, beans), nuts and whole grains (e.g. unprocessed maize, millet, oats, wheat, brown rice).
- At least 400 g (5 portions) of fruits and vegetables a day. Potatoes, sweet potatoes, cassava and other starchy roots are not classified as fruits or vegetables.
- Less than 10% of total energy intake from free sugars which is equivalent to 50 g (or around 12 level teaspoons) for a person of healthy body weight consuming approximately 2000 calories per day, but ideally less than 5% of total energy intake for additional health benefits (5). Most free sugars are added to foods or drinks by the manufacturer, cook or consumer, and can also be found in sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates.

➢ Less than 30% of total energy intake from fats. Unsaturated fats (e.g. found in fish, avocado, nuts, sunflower, canola and olive oils) are preferable to saturated fats (e.g. found in fatty meat, butter, palm and coconut oil, cream, cheese, ghee and lard). Industrial trans fats (found in processed food, fast food, snack food, fried food, frozen pizza, pies, cookies, margarines and spreads) are not part of a healthy diet.

➢ Less than 5 g of salt (equivalent to approximately 1 teaspoon) per day (6) and use iodized salt.

5. Keeping to drinking regime that provides normal water-salt metabolism and creates favorable conditions for the life of the organism. Irregular or excessive water intake worsens digestion, increasing the total volume of circulating blood, creates an additional burden on the cardiovascular system and kidneys, increases the release through the kidneys and sweat glands necessary for the body substances.

Temporary fluid overloading (for example, one intake of a large amount of water (or beer without taking into account the effect of ethyl alcohol in it) disrupts the work of muscles, leads to their rapid fatigue, sometimes causes convulsions.

Due to lack of water well-being worsens, body temperature rises, pulse and breathing become more frequent, working capacity decreases, etc.

Dehydration of body can cause more severe consequences. The minimum amount of water necessary for the body to maintain the water-salt balance during the day (the so-called drinking norm) depends on the climatic conditions, person age, type and load of work.

6. Keeping to day regime, taking into account the dynamics of individual biological rhythms.

7. Personal hygiene. Despite the obvious importance of this multifaceted problem, it still remains underestimated even in the simplest situations. So, the poll conducted by the Gallup Institute showed that only 1% of Americans wash their hands before meals. The risk of getting an infectious disease is largely determined by the environment. Below are the results of microbiological studies to determine the concentration of carriers of infection. They are arranged in order of increasing concentration (increased risk of infection):

1) computer mouse, money, mobile phone;
2) children's sandbox, beach, rest places;
3) office air;
4) air of public transport;
5) handles of toilet doors, handrails of public transport.

8. Hygiene of intellectual work. This is a very important component of a healthy lifestyle, especially for young students.

It is of great importance that the brain can be developed in a wide range by training. It is not so important to have many neurons, you have to be able to work with them. Therefore, daily training is important. Do not use notebooks, but remember phone numbers, addresses, meeting arrangements. Be on disputes, in companies where people argue. You can, for example, take as a rule to learn by heart one poem a day. Another problem is that sometimes in an effort to get an unprecedented result a person focuses himself and his brain on super capabilities. In this situation it is important to realize that if for the development of capabilities the price is training, then in the case of super capabilities is the hypertrophy of one quality at the expense of others and, most likely, premature death.

Memory is of great importance for those engaged in mental work. Memory is not concentrated in one strictly localized area of the brain, similar to the centers of vision or hearing. The memory substrate is brain neurons. It is accepted to distinguish three forms of biological memory: genetic (its carrier is DNA), immunological (includes genetic, but has a higher level) and neurological. The last form of memory is the most complex, in which the short-term and long-term forms are. There are several types of memory: photographic, logical, auditory, visual, etc. It is important to determine what kind of memory you personally have and to make the most of its features. There is a theory that a person remembers everything - the problem is how to remember necessary things.

9. Proper rest. In the conceptual sense, rest is much wider than entertainment or idleness, although in a certain sense they are needed. Much more significant is the ability to alternate work (physical or mental) with rest. From this point of view the scientific works, life and experience of the Nobel laureate, great Russian physiologist, Academician Ivan Petrovich Pavlov are very significant. The main thing is to ensure alternation of activities with rest, even at the level of including different parts of brain in different periods of time. Then the problem of proper rest will be closely related to the problem of rational planning and realization of life during day, week, month, year.

10. Sleep hygiene is a variety of different practices and habits that are necessary to have good nighttime sleep quality and full daytime alertness.

Obtaining healthy sleep is important for both physical and mental health. It can also improve productivity and overall quality of life.

11. Mental health aimed at developing the ability to manage emotions and prevent neuroses.

Mental health is an integral and essential component of health. The WHO constitution states: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." An important implication of this definition is that mental health is more than just the absence of mental disorders or disabilities.

Mental health is a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community.

Mental health is fundamental to our collective and individual ability as humans to think, emote, interact with each other, earn a living and enjoy life.

On this basis promotion, protection and restoration of mental health can be regarded as a vital concern of individuals, communities and societies throughout the world.

Multiple social, psychological, and biological factors determine the level of mental health of a person at any point of time. For example, violence and persistent socio-economic pressures are recognized risks to mental health. Poor mental health is also associated with rapid social change, stressful work conditions, gender discrimination, social exclusion, unhealthy lifestyle, physical ill-health and human rights violations.

There are specific psychological and personality factors that make people vulnerable to mental health problems. Biological risks include genetic factors.

Mental health promotion involves actions that improve psychological well-being. This may involve creating an environment that supports mental health.

Specific ways to promote mental health include:

- early childhood interventions (e.g. providing a stable environment that is sensitive to children's health and nutritional needs, with protection from threats, opportunities for early learning, and interactions that are responsive, emotionally supportive and developmentally stimulating);
- support to children (e.g. life skills programmes, child and youth development programmes);
- socio-economic empowerment of women (e.g. improving access to education and microcredit schemes);
- social support for elderly populations (e.g. befriending initiatives, community and day centres for the aged);
- programmes targeted at vulnerable people, including minorities, indigenous people, migrants and people affected by conflicts and disasters (e.g. psycho-social interventions after disasters);
- mental health promotional activities in schools (e.g. programmes involving supportive ecological changes in schools);
- mental health interventions at work (e.g. stress prevention programmes);
- housing policies (e.g. housing improvement);
- ·violence prevention programmes (e.g. reducing availability of alcohol and access to arms);
- community development programmes (e.g. integrated rural development);
- poverty reduction and social protection for the poor;
- anti-discrimination laws and campaigns;
- promotion of the rights, opportunities and care of individuals with mental disorders.

12. Sexual education; prevention of sexually transmitted diseases. The sexual side of life as a component of harmonious, healthy lifestyle is worthy of

detailed consideration. This includes the notion of the norm and pathology of sexual life, partner sexual norm and other aspects of person's intimate life. However, one of the problems of sexual education should be connected first of all with the prevention of abortion.

13. Safe behavior in the home, on the street, in educational institution or at work, ensuring prevention of injuries and poisoning.

14. Responsibility for the health of future generations. The health of our children and future generations depends on us.

Answer these questions:

1. What is the «security»?
2. What is Kazakhstan's place in life expectancy?
3. Which country ranks first in terms of life expectancy?
4. What factors affect life expectancy?
5. What is the «danger»?
6. Which groups classify dangers?
7. Do you lead a healthy lifestyle?
8. What bad habits do you have?

Topic: Emergency of nature character

Goal: to study the diversity of natural emergency, the causes of their occurrence, the consequences and actions of the population before, during and after them

Plan:

1. Emergency of nature character
2. Earthquakes
3. Landslides, sill flows
4. Hurricanes, storms, tornadoes
5. Flood
6. Natural fires

Emergency of nature character

Natural disaster is a natural phenomenon causing an emergency situation that threatens life and health of people and leads to large material losses.

Many dangerous natural phenomena are closely connected. For example, an earthquake can cause landslides, landslip, mudflow, flood, tsunami, avalanches, activation of volcanic activity. Many storms, hurricanes, tornadoes are accompanied by downpours, thunder and hail. Strong heat is accompanied by drought, lowering of groundwater, fires, epidemics, invasions of pests.

Depending on the origin (nature) and mechanism of action, dangerous natural phenomena can be divided into 6 groups:

1. Geophysical hazards: earthquakes, volcanic eruptions.

2. Geological hazards (exogenous geological phenomena): soil slip, torrent, fall of ground, avalanches, ground subsidence.

3. Meteorological and agrometeorological hazards: hurricanes, storms, tornadoes, dust storm, squall, hailstorm, rainstorm, blizzard, glaze, frost, dense fog, drought, dry hot wind.

4. Marine hydrological hazards: typhoon, storm, heavy fluctuations in sea level, intensive ice drift.

5. Hydrological hazards: high water, low water, flood, early freezing on navigable water bodies and rivers, flooding (ground water rise).

6. Natural fires: forest fires, fires of steppe and grain massifs, peat fires, underground fires of fossil fuel.

Among the most dangerous natural disasters are earthquakes, landslides, mudflows, landslides, hurricanes, storms, tornadoes, floods, forest and peat fires.

Earthquakes

Earthquake is any sudden shaking of the ground caused by the passage of seismic waves through Earth’s rocks. Seismic waves are produced when some form of energy stored in Earth’s crust is suddenly released, usually when masses of rock straining against one another suddenly fracture and “slip.” Earthquakes occur most often along geologic faults, narrow zones where rock masses move in relation to one another. The major fault lines of the world are located at the fringes of the huge tectonic plates that make up Earth’s crust.

When earthquakes occur under water there are huge (sometimes over 60 m high) waves - tsunamis bringing on land huge destruction.

The earthquake focus is the area of energy release. It occurs most often at a depth of 10 – 100 km. In the center of the focus there is a point called hypocentre.

The epicenter of the earthquake is the projection of the center of the focus on the earth surface. Around it is the area of greatest destruction

The intensity of earthquake manifestation on the Earth's surface is measured on the MSK-64 seismic scale having 12 conditional grades (1 to 4 points – weak earthquakes, (5-7) – strong, (8 to 10) – destructive, (11-12) – catastrophic).

The consequences of earthquakes are extremely dangerous. They cause stretching, flow and subsidence of the ground, collapses, rockfalls, wide cracks, landslides, avalanches, mudflows, tsunamis and seiches; lead to damage and destruction of buildings, fires, explosions, emissions of harmful substances, transport accidents, failure of life support systems, cause great general damage, people death and injury.

Often after an earthquake there could be panic during which a person in fear does absurd and dangerous for himself and others things and is unable to take measures to save himself and help others. Panic is especially dangerous in places of congestion: at enterprises, in educational and children's institutions, hostels, venues for entertainment events, large residential areas.

Very seldom the cause of death is the direct movement (vibration) of soil. Most of the victims are the result of concussion, destruction of buildings and structures. That's what causes death, injuries in the earthquake: fall of bricks, chimneys, cornices, balconies, moldings, facing slabs, frames, lighting installations, equipment of some parts of building; flying out (especially from upper floors) broken glass; torn electric wires hanging or falling on the roadway; falling heavy items in the apartment; fires caused by gas leakage from damaged pipes and the closure of electric lines; panic. However, the number of victims can be significantly reduced if to prepare in advance for a possible earthquake (especially in seismic regions), to analyze actions and follow a number of recommendations.

All adult members of family (residents of house) should be able to turn off electricity, gas and water in the apartment, entrance, house, and also provide first aid, especially with trauma; prepare the most necessary things (objects) in advance and store them in a place known to all family members.

This is a radio receiver with batteries, a supply of canned food and drinking water for 3 to 5 days, a first aid kit with a double stock of dressings and a set of drugs needed for chronically ill family members, a portable electric lantern, a bucket of sand, and an automobile fire extinguisher.

Documents should be kept in one easily accessible place, preferably near the entrance to the apartment; there it is advisable to have a backpack in which there should be a lantern, hatchet, matches, food, first-aid kit, candles, spare clothes and shoes (according to the season) for the whole family. If you have a garage, a garden house, if possible, use them as a refuge in the first days after strong earthquake; here you can store a supply of food and clothing.

Cabinets, shelves, racks must be firmly attached to walls and floor; furniture to place so that it could not fall on sleeping places, block the exits from the rooms, block the doors; heavy things lying on shelves or furniture (including mezzanines), securely fastened or moved down; do not arrange shelves over bunks, entrance doors, plates, sinks, toilets; close the front of shelves with utensils, secure chandeliers and fluorescent lights well.

The entrance to the apartment, corridors and staircases shouldn't be cluttered up with things.

Containers with flammable substances and corrosive liquids should be kept securely sealed and stored so that they can not fall and break when the building oscillates.

It is necessary to conduct periodic trainings, to think over how to improve safety of children, elderly people, disabled people and patients; in advance to determine the safest places (in the apartment, at work, near the workplace), where you can wait out shocks.

You should hide from falling objects and pieces under solid tables and beds.

In case of a strong earthquake it is better to leave building. You can not use lift, therefore, there could be many people in the doors and the aisles, and this can prevent rapid exit from building. You can get out through window openings of the ground floor.

You can not light matches, candles and use lighters during or immediately after earthquake.

If the earthquake has caught you while traveling in a car, stop where your car does not interfere with the other transport and stay in it.

After the earthquake, be sure there are no injuries, examine the surrounding people and, if necessary, help them; seriously wounded should not be moved from the place unless they are endangered by extreme danger (fire, collapse of structure, etc.); help people who have fallen into easily removable blockages, and be extremely careful; if they require additional medical and other special assistance, then wait for it; ensure the safety of children, sick, old people, calm them. Use the phone only in case of emergency (the telephone network will be overloaded).

You must be ready for new shocks. They can happen in a few days, weeks and even months. It is impossible to say in advance when the danger of their recurrence has completely passed.

When the epicenter of the earthquake is in the sea, it is necessary to leave immediately the coastland.

If you are in the rubble:

1. Free yourself from the debris lying on you, and carefully examine yourself. (Touch your head, see if there is blood in your ears, take a deep breath - whether your chest is intact, try raising your legs.)

2. If there are no serious injuries, turn face down and try to move to a safer place. Strengthen your shelter with fragments of stones, exclude movement of plates, unbend sharp pieces of armature.

3. In whatever condition you are, try to let somebody hear - knock on pipes, fittings, etc.

4. Find the source of air intake; expand and strengthen the way to it (Air consumption per breath: 1 person – 1 m^3/hour).

5. Do not lose hope of salvation; hold out until the arrival of rescuers! Even in the most difficult obstructions people remain alive.

Landslides, sill flows

Landslides are the displacement of rocks masses down the slope under the influence of gravity. They are formed in different rocks as a result of their imbalance and weakeness, and are due to both natural and artificial (anthropogenic) causes. Natural causes include: increase of slopes steepness, underwashing of their bases with sea and river waters, seismic shocks, etc. Artificial causes are: destruction of slopes by road excavations, excessive removal of soil, deforestation; incorrect choice of agrotechnics for agricultural land on slopes, etc. According to international statistics, up to 80% of modern landslides are connected with human activities (anthropogenic factor).

Landslides occur with the slope of 10° or more. On clay soils with excessive moistening they can be even at a steepness of 5-7°. Landslides are classified according to force, activity, mechanism and power of the landslide process, place of formation.

Sill flow — a rough mud or mudflow suddenly arising in the channels of mountain rivers, tracts, on steep mountain slopes.

Sill emerges as a result of combining at least three factors:

- existence or appearance of large water reserves at a sufficient height;
- presence of steep drain;
- sufficiently large reserves of stones, boulders, fragments of rocks, which will form the body of mudflow.

The process of formation and development of sills passes through 3 stages: the first stage is accumulation in the channels of mudflow basins of loose material due to rocks weathering and mountain erosion; the second stage - movement of loose mountainous materials along mountain beds from high areas to low ones; the third stage is concentration of mudflow cone in mountain valleys.

The movement of sill is a continuous stream of mud, stones and water. Sill flows can carry individual fragments of rocks with a mass of 100 to 200 tons or more.

The reasons of sills emergence are heavy rains, washing of reservoir bridges, dumping of water by tornado, intensive thawing of snow and ice, as well as earthquakes and volcanic eruptions.

The main striking factors of these disasters are the impacts of moving masses of rocks, as well as flooding of previously free space. As a result, residential buildings and other structures are collapsing; settlements, objects of the national economy, agricultural and forest lands are under rock masses; river beds and overpasses are overlapping; people and animals die; landscapes are changing. The railway traffic is blocked. Bridge supports, rail tracks, road coverings, power and communication lines, gas and oil pipelines, hydroelectric power stations, mines and other industrial enterprises are destroyed and damaged.

Sill flows lead to flooding and blockages of agricultural crops with detrital materials. Arable lands, located below landslide areas, are often swamped. All the above mentioned leads not only to the loss of crops, but also simply to land loss in agricultural rotation. The significant damage can be done to the cultural and historical heritage of peoples inhabiting mountainous areas.

The population living in the landslide, mudflow and rockslide danger zones should know the focus, possible directions and main characteristics of these dangerous phenomena. On the base of the forecast data, people are informed in advance about the identified landslide, mudflow, rockslide areas and possible areas of their activity, periods of mudflow passage, as well as the procedure for signaling the threat of emergency situation.

For emergency exit it is necessary to know the way of movement to the nearest safe places. The natural safe ways for immediate evacuation are the slopes of mountains and hills, not subject to landslide processes or those between which there is a dangerous path. When climbing to safe slopes, you can not use valleys, gorges and excavations, because they may form side channels of the main mudflow. During evacuation help should be provided to patients, the elderly people, the disabled, children, weak.

Hurricanes, storms, tornadoes

Hurricane is the wind of great destructive power and considerable duration. The lower limit of wind speed on the Beaufort scale in the hurricane is 33 m/s (120 km/h), although it can exceed 200 km/h. Hurricane is 12 points on the Beaufort scale. When spreading over the sea it produces waves more than 12 m in height; destruction of ships, destruction of coastal structures.

On land it destroys buildings, communication lines and power lines, transport communications, bridges, tears up trees, devastates fields. The principal feature of hurricane is the straight-line (as a ray of light) spread of air masses. Therefore the idea of an air shadow arises which is very useful in finding the place of shelter. It is better to take shelter in such shadow, that is, behind obstacles opposing the heavy wind, or in recesses letting the wind go.

Windstorm (storm) – a kind of hurricane, inferior to it in force. (Wind speed is 70 – 115 km/h, 8 – 11 points on the Beaufort scale.) On the ground surface it causes erosion and soil weathering together with crops seeds, drying and filling of shoots, revealing the root system, etc.

Whirlwind (tornado) – rising vortex of rapidly rotating air, which looks like earth (water) column with the diameter up to hundreds of meters with the vertical (sometimes curved) axis of rotation. Inside the pillar is vacuum (low pressure), which causes absorption of everything on tornadoes way (soil, sand, water, etc.).

The main types of people injury are closed injuries of parts of body, bruises, fractures, brain concussions, injuries accompanied by bleeding.

Immediate warning should be started in the case of storm warning:

- strengthen inadequate structures and cranes, billboards and structures;
- close doors, attic spaces, dormer windows, vents in buildings;
- board large windows and showcases;
- doors and windows on the leeward side should be left open (the seeming unusuality of such action is explained by the fact that when the air flow is obstructed by an obstacle (house), the area of low pressure is created on the back of it, and the resulting pressure difference must be leveled);
- remove items from roofs, balconies, loggias; if dropped, they can cause injuries;
- make supply of water, food, medicines (especially bactericidal medicines (iodine, green antiseptic, etc.) and dressings.

In city billboards, broken wires under pressure, old-age poplars are of great danger.

The safest place during the hurricane is civil defense protective structures, cellars and interior spaces of the first floors of brick buildings.

If hurricane, storm or tornado caught you in open space, it is best to hide in a ditch, pit, ravine, any pothole – to lie down on the bottom and snuggle up to the ground.

Flood

Flooding - a significant flooding of the area as a result of rising water in a river, reservoir or sea causing material damage to the economy, the social sphere and the natural environment.

There are the following types of floods depending on their causes:

1. Floods connected with the maximum runoff of water due to spring melting of snow. They are distinguished by a significant and rather long rise in the water level, but are usually not accompanied by damage.

2. Floods formed by rain or snow melting in high mountain areas or winter thaws

3. Floods caused by high resistance, which the water flow meets in the riverbed.

4. Floods during the breakthrough of dams, hydraulic structures.

5. Floods caused by underwater earthquakes or volcanic eruptions and connected with tsunamis.

6. Floods created by wind surges on the shores of large lakes, reservoirs and in the mouths of large rivers.

Direct consequences:

1. Death of people and animals.
2. Destruction and damage of buildings, structures, outbuildings, etc.
3. Loss of harvest.
4. Destruction of the fertile soil layer (washout, siltation, sand deposition).
5. Change of landscape.
6. Interruption of economic activity.

Secondary consequences:

1. Loss of strength of various structures (erosion, washing).
2. Water transportation of harmful substances and pollution of large areas.
3. Water logging.

With getting of the flood forecast, people are informed and the flood commission starts its work. Before evacuation it is necessary:

- turn off gas, electricity, water supply;
- move all the valuable things to the upper floors;
- collect necessary documents, money, valuables, supplies, medicines, stock of products, etc.

Natural fires

Natural fires are divided into forest, peat and grass. Their occurrence is most likely in fire-dangerous season (late dry, hot spring, summer, autumn).

Weak fires have speed up to 1 m/min, flame height ≤0.5 m; medium fires – 1-3 m/min, flame height 0.5-1.5 m; strong ones – ≥ 3 m/min, flame height ≥ 1.5 m.

Forest fires are crown and ground. Ground fire is forest fire spreading through the lower tiers of forest vegetation, forest litter. Crown fire is forest fire covering forest canopy.

Peat fires are characterized by flameless burning of peat with the accumulation of a large amount of heat. By the speed of spreading they are inferior to forest fires. Even strong peat fires have speed about 0.5 m/min.

Grass fires occur both for natural reasons (lightning), and when burning dry past year grass or stubble left after harvesting cereals.

Consequences of natural fires:

- Destruction of forest resources
- Air pollution
- Destruction of the fauna and its habitat
- Disruption of water protection and environmental protection properties of forests
- Destruction of populated areas, farmland, power lines, pipeline transport
- Disruption of economic activity.

Prevention of forest and peat fires includes:

1. Assessment and forecast of fire hazard;

2. Fire reconnaissance (type, characteristics, directions, possible natural barriers to spread, places increasing fire – coniferous young stock, timber warehouses, etc.);

3. Fire fighting which includes:

3.1 Stop - stop burning flames on the edge.

3.2 Localization – additional processing of the edge, excluding the possibility of combustion renewal and spread.

3.3 Quenching – elimination of foci within fire.

3.4 Watching – preventing the possibility of fire from undetected fires (continuous or periodic control of fire perimeter).

Answer these questions:

1. Give the definition of emergency of nature character.
2. To which group of natural emergencies does the storm belong?
3. List hydrological hazards.
4. What should you do during the earthquake, if you are indoors?
5. What should you do before the evacuation in case of a flood threat?
6. What are the consequences of natural fire?

Topic: **Emergency of technogenic character**

Goal: to study the variety of emergencies of technogenic character; their features and main actions of population before, during and after the situation.

Plan:

1. Emergency of technogenic character
2. Radiation safety
3. Chemically hazardous substances, ecotoxicology
4. Fire safety
5. Explosion protection
6. Electric shock

Emergency of technogenic character

The technogenic factor is the most common cause of emergencies. Technogenic emergency is the condition when by the result of the emergence of a source of technogenic emergency on the site, certain territory or water area, normal living conditions are violated, there is a threat to life and health of people, and that leads to damage of the property of population, the national economy and the environment.

Dangerous technogenic accidents include accidents at industrial facilities or transport, fires, explosions or release of various types of energy.

Technogenic dangers are usually classified according to the elements of the technosphere, which are sources of dangers:

- Mechanical danger - from moving parts of machines and mechanisms.
- Chemical danger - from existing chemical productions and use of products.
- Energy danger - from objects that are sources of various energy, as well as radioactive materials and sources of radiation of various origin (electric current, static electricity, electromagnetic fields, laser radiation, radiation of the optical range, ionizing radiation).
- Biological danger - from objects connected with the study of microbiological processes and production based on these processes, as well as objects of agriculture.

The methodology of protection from technogenic hazards is based on generally accepted principles and methods of protection from dangers. First of all the quantitative assessment of danger is made, after which the necessity and the degree of protection is determined. The method of protection and its technical implementation are chosen individually in each specific case.

Radiation safety

Radiation has always been a natural part of our environment. Natural radioactive sources in the soil, water and air contribute to our exposure to ionizing radiation, as well as man-made sources resulting from mining and use of naturally radioactive materials in power generation, nuclear medicine, consumer products, military and industrial applications.

Where does radiation exposure come from (fig. 10)?

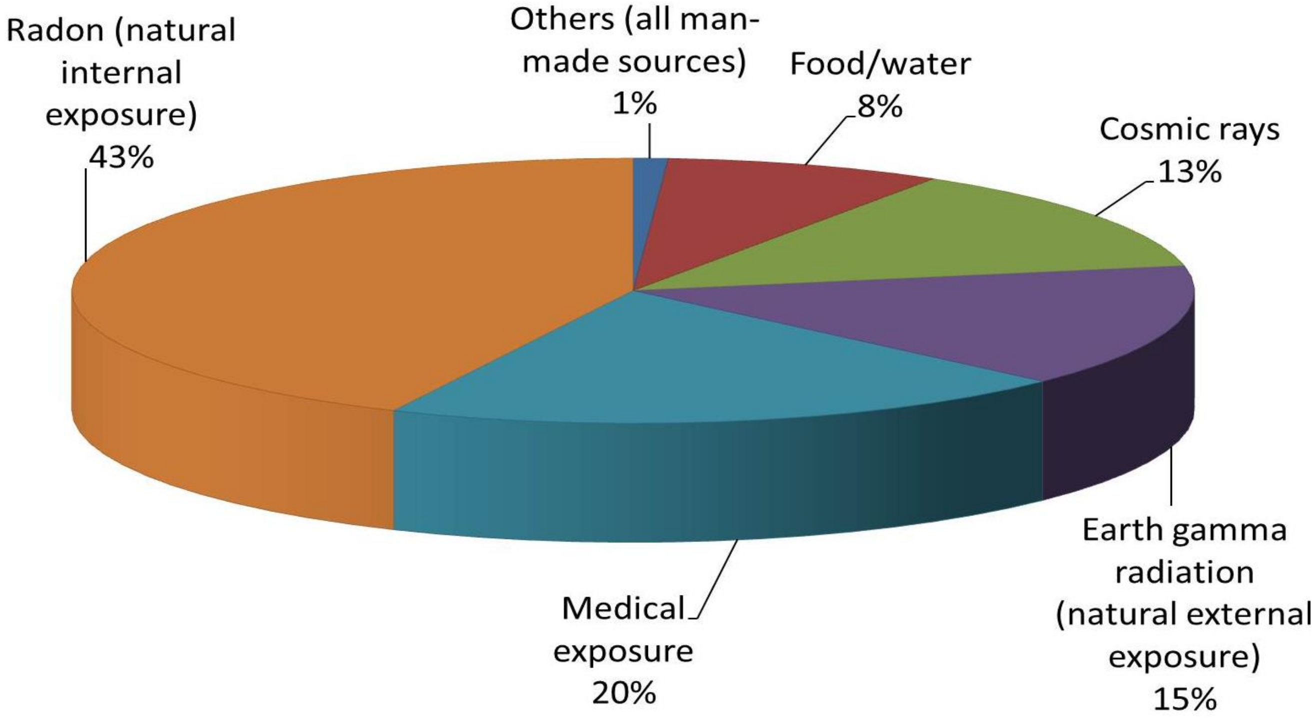

Figure 10 - Sources and distribution of average radiation exposure to the world population

The scale and types of radiological and nuclear emergencies may range from an isolated occupational or medical over-exposure of a person, to a major catastrophe with global dimensions.

Throughout the world, but particularly in technologically advanced countries, there are a large number of nuclear installations, the regulatory bodies for which require the development and maintenance of site specific emergency preparedness and response plans. There are also many other types of facilities and activities that involve the use of radiation or radioactive material for agricultural, industrial, medical, scientific and other purposes. Such facilities and activities include, for example, the production, use, import and export of radiation sources; the transport of radioactive material; the decommissioning of facilities; or satellites carrying radioactive material. The response to a nuclear or radiological emergency may involve many national organizations (e.g. the operating organization and response organizations at the local, regional and national levels) as well as international organizations. Therefore, the response to a nuclear or radiological emergency has to be well coordinated.

For strengthening coordination in response to radiation emergencies the international organizations with relevant responsibilities have formed IACRNE, where International Atomic Energy Agency (IAEA) is the prime coordinating agency. Functional links have been established between agencies to ensure continuous communication prior to, during, and after emergencies and the arrangements are described in the Joint Radiation Emergency Management Plan of the International Organizations (EPR-JPLAN 2013).

The IACRNE was established in September 1986 in the aftermath of the Chernobyl accident. Members of IACRNE develop, maintain and co-sponsor the Joint Radiation Emergency Management Plan of the International Organizations — the Joint Plan. The Joint Plan describes a common understanding of how each organization acts during a response and in making preparedness arrangements. The IAEA provides the secretariat for the IACRNE and coordinates the development and maintenance of the Joint Plan.

The IAEA established the IEC in 2005 in response to an increased use of nuclear applications coupled with heightened concerns over the malicious use of nuclear or radioactive materials. While emergency response capabilities have existed within the IAEA since the conclusion of the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, the decision to create an integrated Centre was taken to provide round-the-clock assistance to Member States in dealing with nuclear and radiological events, including security-related threats, by coordinating the efforts, contributions and actions of experts within the IAEA, Member States and international organizations. The IEC is also the custodian of the IAEA's Incident and Emergency System (IES).

The work of the Centre focuses on four areas: IES Preparedness; IES Operations; Member States preparedness; and emergency communications and outreach.

Any nuclear or radiological emergency requires effective response commensurate with the level of actual, potential or perceived hazard. This can be accomplished through the adoption of an event/emergency classification composed of sets of conditions that trigger a certain level of response (tab. 3).

Table 3

Classification of nuclear and radiological events

General emergency	Events resulting in an actual, or substantial risk of release of radioactive material or radiation exposure warranting taking precautionary urgent protective actions, urgent protective actions, early protective actions and other response actions on the site and off the site.
Site area emergency	Events resulting in a major decrease in nuclear safety warranting taking protective actions and other response actions on the site and in the vicinity of the site but not sufficient to meet criteria for 'general emergency'.
Facility emergency	Events resulting in a significant decrease in nuclear or radiation safety at the facility warranting taking protective actions and other response actions at the facility and on the site but not warranting taking protective actions off the site.
Alert	Events resulting in an actual or potential decrease of nuclear or radiation safety at the facility warranting taking actions to assess and mitigate, as necessary, the potential consequences at the facility.
Other events	Any other event in a facility that may trigger public concerns and media interest
Radiological emergency	Any event which is of actual, potential or perceived radiological significance warranting protective actions and other response action at any location and is not a nuclear emergency

There are 5 types of radiation exposure on person.

1. External irradiation during the passage of a radioactive cloud. In this situation a person is separated from danger, at least by air. The best way to protect against external radiation exposure should be materials containing heavy chemical elements, for example, lead metal, lead paints, leaded rubber, barite plaster, etc. The tree is represented by hydrocarbons, consisting of atoms of light elements, so sufficiently effective protection can be achieved with a large thickness of wooden floors. These circumstances should be taken into account when choosing a specific shelter.

2. Internal exposure by inhalation of radioactive aerosols (inhalation hazard). The origin of aerosol is the contents of a radioactive cloud or radioactive dust raised from the ground. Getting through the respiratory tract inside the body, radioactive radiation directly affects the internal organs of a person. Internal irradiation is always many times more dangerous than

external irradiation. Measures and means of protection for this type of exposure will be those that will not allow radioactive aerosols to penetrate the respiratory tract.

3. Contact exposure due to radioactive contamination of skin and clothing. In sense it refers to external exposures, measures and means of protection are understandable and easily representable.

4. External irradiation caused by radioactive contamination of the ground surface, buildings, structures. The greatest attention is required to situations in which radioactive materials falling out of the cloud are spreading through secondary processes (by wind or running water, smothering in the ground, etc.).

5. Internal irradiation as a result of consumption of contaminated food and water. It is important to protect water and foodstuffs from getting into them radioactive isotopes. Sources of water (wells, springs, etc.) should be covered with dense lids, and if there is no confidence in the quality of protection or it is impossible in principle, the water should be carefully filtered. Food products must be pre-sealed, and if it is plant food grown in the contaminated zone, or it is meat of herbivores from the same zone, etc., effective monitoring can provide effective safety and competent processing of products.

The actions of population depend on the time until the moment of radiation exposure and the situation.

<u>Prior to the moment of the possible radiation damage more than 1 day:</u>

1. Prepare documents, money, valuables, food, clothing, personal protective equipment, necessary items for evacuation.

2. Receive or prepare at home the medical means of protection and prevention of radiation damage.

3. Prepare and put home under security.

4. Make evacuation documents

5. Evacuate beyond the 30-kilometer zone (by private transport or organized).

6. Perform the duties of a member of the civil defense formation in accordance with official duties or instructions.

<u>Prior to the moment of the possible radiation damage from 1 day to 1 hour:</u>

1. Prepare personal protective equipment and apply if necessary.

2. Receive an individual first-aid kit or prepare medical means of protection and prevention of radiation damage independently.

3. Perform iodine prophylaxis, combine with it the prevention of strontium-90 damage.

4. Evacuate beyond the 30-kilometer zone.

5. If you stay in the zone of possible radiation damage, then stay indoors, seal it, hide food and water.

<u>Prior to the moment of possible radiation damage less than 1 hour:</u>

1. Prepare personal protective equipment and apply if necessary.

2. Receive an individual first-aid kit or prepare medical means of protection and prevention of radiation damage.

3. Perform iodine prophylaxis, combine with it the prevention of strontium-90 damage.

4. Take 6 tablets of cystamine.

5. Use the means of collective protection.

6. Stay indoors, seal it, hide food and water.

<u>You are in the area of radiation damage:</u>

1. Use personal protective equipment.

2. Perform iodine prophylaxis, combine with it the prevention of strontium-90 damage.

3. Take 6 tablets of cystamine, and after 6 hours and need to remain in the area of radiation damage take 6 more tablets.

4. If necessary, take an anti-emetic.

5. Use the shelter (especially in the period of radioactive fallout).

6. Stay indoors, seal it, hide food and water.

<u>After leaving the zone of radiation damage:</u>

1. Remove the outer clothing (cloak) and, standing with your back to the wind, shake it out and hang it on a rope or crossbar. Place radioactive dust from the top down or poke it with a stick.

2. Remove dirt from shoes and wipe with cloth or brush.

3. Rinse clothing and linen for washing in running water.

4. Remove and hand over to the firing point PPE (if necessary, bury it in the ground).

5. Remove the gloves.

6. Wash your hands thoroughly with soap and water, and clean your nails well.

7. Wash your face so that water does not get into eyes, nose, mouth.

8. Rinse mouth, throat, and eyes with clean water.

9. At the first opportunity have full sanitary treatment and dosimetric control.

10. In living area vacuum clean or dust furniture and do wet cleaning.

Chemically hazardous substances, ecotoxicology

At present more than 6 million chemical compounds are known (more than 90% of them are organic). Practically all substances are dangerous in one way or another and in various conditions, and only a few dozen belong to the category of chemically dangerous. Chemicals that are intended for use for economic purposes and have toxicity that can cause massive damage to people, animals and plants are called chemically hazardous substances (CHS).

Classification of chemically hazardous substances according to the degree of danger of impact on people:

I – extremely dangerous (compounds of mercury, lead, cadmium, zinc, metal carbonyls, substances containing cyanide ions (hydrocyanic acid and its salts), halogens (Cl_2, Br_2), halocarbons (HF, HCl, HBr), chlorohydrins, organofluorine compounds, phosphorus compounds, etc.);

II – highly dangerous (mineral and organic acids (sulfuric, nitric, hydrochloric, acetic), alkalis (sodium hydroxide), ammonia, sulfur compounds (sulfides, thioacids, carbon disulfide), halogenated hydrocarbons (methyl chloride, methyl bromide), some alcohols and aldehydes (methanol, formaldehyde));

III, IV – moderately and low-risk (all other chemical compounds).

Classification of chemically hazardous substances by the nature of impact on people:

1. Substances with predominantly suffocating action:

1.1 with concentrated cauterizing action (chlorine, etc.);

1.2 with weak cauterizing action (phosgene, etc.).

2. Substances of general toxic effect (cyanide, hydrogen cyanide (hydrocyanic acid and its salts).

3. Substances possessing suffocating and generally toxic effect:

3.1 with concentrated cauterizing action (nitrile acrylic acid, etc.);

3.2 with weak cauterizing action (sulfurous anhydride, hydrogen sulphide, nitrogen oxides, etc.).

4. Neurotropic poisons acting on generation, carrying out and transmission of nerve impulses (carbon disulfide, etc.).

5. Substances of asphyxiating and neurotropic action (ammonia, etc.).

6. Metabolic poisons, which poison the body as a result of not direct action, but intracellular metabolism and their biochemical conversion into hazardous compounds (methylene chloride, ethylene oxide, etc.).

7. Carcinogenic substances.

Carcinogenic substances are responsible for emergence and development of cancer diseases (tab. 4).

Table 4

Carcinogenic compounds and target organs

№	The name of the chemical factor	Target organs
Natural and industrial carcinogens		
1	Asbestos	Lungs, pleura, peritoneum (gastrointestinal tract, larynx)
2	Benzene	Hematopoietic system
3	Beryllium and its compounds	Lungs (central nervous system)
4	Vinyl chloride	Liver, blood vessels (brain, lungs,

		lymphatic system)
5	Cadmium and its compounds	Lungs, prostate gland
6	Mineral Oils	Skin (lungs, bladder, gastrointestinal tract)
7	Arsenic and its compounds	Lungs, skin
8	Nickel and its compounds	Nasal cavity, lungs
9	Radon and its decay products	Lungs
10	Carbon black	Skin, lungs
11	Shale oils	Skin (gastrointestinal tract)
12	Talc containing asbestos fibers	Lungs
13	Chromium hexavalent and its compounds	Lungs (nasal cavity)
	Carcinogenic drugs	
14	Analgesic mixtures containing phenacetin	Bladder, kidney
15	Diethylstilbestrol	Cervix / vagina, testicles, mammary gland, (uterus)
16	Oral contraceptives used cyclically	Uterus
17	Contraceptives, oral, combined	Liver
18	Replacement estrogen therapy	Uterus (mammary gland)
19	Nonsteroidal estrogens	Cervix, vagina, mammary gland, testicles (uterus)
20	Steroid Estrogens	Uterus (mammary gland)
21	Cyclosporin	Lymphatic system

The group of heavy metals includes lead, copper, zinc, nickel, cadmium, cobalt, antimony, bismuth, mercury, tin, vanadium with the exception of noble and rare metals, which have density more than 8,000 kg/m^3. Such separation looks rather conditional and usually the group of heavy metals also includes chromium, silver, gold, platinum, iron, manganese, and also semimetal arsenic. Many of these agents are capable of causing disease in humans and are widespread in the environment.

Clinical syndromes of lead poisoning:

1. Changes in the nervous system include: a) asthenic syndrome – functional disorders of the central nervous system (headaches, fatigue, memory impairment, etc.); b) encephalopathy (from headaches and epileptic seizures to "leaden meningitis" and violations of speech and auditory functions); c) motor disorders – paresis and paralysis, polyneuritis with a predominant lesion of the extensor muscles; d) visual analyzers damage.

2. Changes in the blood system – from reticulocytosis, anisocytosis and microcytosis to lead anemia, more often oligochromic.

3. Endocrine and metabolic disorders (enzymatic disorders, impaired metabolism of porphyrins, menstrual and genital functions).

4. Changes from the gastrointestinal tract (from nausea, heartburn to lead colic).

5. Changes in the cardiovascular system (arrhythmia, sinus bradycardia or tachycardia, vasoneurosis).

6. Impaired renal function.

Rules of safe behavior and actions of the population in case of accidents with the release of CHS.

The main methods of protection from ACHS (accidentally chemically hazardous substances) are:

1. Refuge in shelters and sealed rooms.

2. Use of personal protective equipment, taking into account which CHS is the source of infection.

3. Restriction of time of stay in the open area.

4. Removal of CHS from skin, mucous membranes and from the body; neutralization of CHS or products of its decay.

When receiving the warning on the threat of chemical contamination, it is recommended for people to take the following actions immediately:

1. Wear personal protective equipment (PPE) – respiratory equipment and leave the area of infection.

2. If you can not get out of the contamination zone, stay indoors, put on personal respiratory protective equipment, seal the room (use various tapes, adhesive plaster, paper to fill up the cracks in the windows and doors, close chimneys and ventilators).

3. In case of impossibility of further staying in the room, it is necessary to disconnect heating and household electrical appliances, gas, dress children and elderly people, take warm clothes and non-perishable products for 3 days, and, going out, move perpendicular to the direction of the wind, following such rules:

- move fast, but do not run and make dust;
- use means of protection;
- do not lean against buildings and do not touch surrounding objects;
- avoid passage through tunnels, ravines and other open reclining places;
- when leaving the contaminated area, remove the outer clothing and leave it on the street, rinse the eyes and open areas of the body with water, take a warm drink, if necessary, seek medical help.

4. If possible, provide the necessary assistance to victims.

Basic principles of first aid:

1. Stop CHS intake into the body (remove the affected person from the contamination zone, remove CHS from the skin or from mucous membranes, remove contaminated clothing);

2. Restoration of impaired body functions and maintenance of life (artificial respiration, cardiac massage);

3. Removal of CHS from the body (gastric lavage, emetics, adsorbents);

4. Use of appropriate antidotes and medications that enhance the protective properties of the body.

Fire safety

Fire - uncontrolled combustion process, accompanied by the destruction of material values and creating danger to life and health of people.

Burning is any reaction of oxidation-reduction, in which heat is released.

In the zone of strong fire there will always be deficit of oxygen, therefore, poisonous carbon monoxide will always be released, therefore, there will always be threat of poisoning. The characteristic of fire is carbon monoxide poisoning.

Carbon monoxide is the strongest known poison. Its action is analogous to the action of cyanides: they form very strong chemical compounds with the atoms of iron, which is part of hemoglobin in blood. Thus, they block hemoglobin and make it unable to carry oxygen to the cells of body.

It is not registered by our senses, since it has no color, no smell, no taste. It does not dissolve in water, therefore, protection of respiratory organs from it with the help of moist tissue is useless and meaningless. Carbon monoxide is not absorbed by a civil gas mask. Exposure to carbon monoxide at concentrations ranging from 1,000 to 10,000 ppm causes headache, dizziness and nausea after exposure for 13 to 15 minutes, loss of consciousness and death if exposure continues for 10 to 45 minutes. With the massive nature of the impact, a person can almost instantly lose consciousness even without any warning symptoms.

Fire components, or necessary and sufficient fire conditions:

FUEL SUBSTANCE + OXIDIZER + IGNITION SOURCE ⇒ FIRE

This approach, on the one hand, highlights the conditions of fire safety (almost always there are combustible substances in the atmosphere of oxygen and the appearance of fire is the result of the emergence of a source of ignition, although other combinations are possible in life), and, on the other hand, it shows the ways of extinguishing fire (removing at least one component from the circuit will lead to cessation of combustion).

Combustible substances – fuel (wood, peat, stone and charcoal, slate, oil and products of its processing), dry plants (hay, straw, etc.), cotton, paper, lubricants, polymeric materials, etc. Oxidizers - oxygen, halogens (Cl_2, Br_2), nitric acid (HNO_3), sulfuric acid (H_2SO_4), chlorates ($KClO_3$), perchlorates ($KClO_4$), nitrates ($NH4NO_3$), etc.

Ignition sources – flame matches, lighters, candles, etc.; not smashed cigarette butt; molten metal during welding; open fire; static electricity; atmospheric electricity; the sun; electrical equipment; devices; friction.

Combustion products - products of incomplete combustion, poisonous products (carbon monoxide, dioxin – metabolic poison – as a product of burning polyvinylchloride and PVC products – linoleum, pipes, heat and sound insulation blocks, toys, containers, etc., PVC production takes the second place after the production of polyethylene), combustion products of impurities (oxides of sulfur, nitrogen, etc.), solid and liquid particles that form smoke.

Fires can result from:

- careless handling of fire;
- childish prank;
- congestion of the electricity network;
- malfunctioning of electrical equipment;
- household gas leaks;
- accident;
- natural disaster;
- sabotage;
- terrorist act.

The damaging factors of fire and the results of their exposure to humans:

1. Exposure to toxic smoke.
2. Exposure to high temperatures, incl. hot air.
3. Deterioration of visibility.
4. Electric shock.
5. Collapse of structures.
6. Explosion.
7. Panic (especially in venues for entertainment events, hotels, etc.)

The consequences of fire for person and his health are as follows:

1. Poisoning.
2. Strangulation (lowering the oxygen content in the air by 3% significantly impairs motor functions, and by 14% – completely violates coordination of human movements).
3. Burns of the body and respiratory tracts (inhalation of hot air (temperature above 100°C) leads to necrosis of the respiratory tract, suffocation, loss of consciousness and death in a few minutes).
4. Injuries.
5. Electric shock.
6. Paralysis of will of an unprepared person.

The main methods of stopping combustion in extinguishing fires:

1. Removal of combustible materials from the combustion zone (this is realized, for example, by rolling with the help of poles the logs of a burning

village house or by the organization of an oncoming fallow, or mineralized strips in extinguishing forest fires, etc.).

2. Insulation of the combustion zone from the access of the oxidizer (from the triad of conditions the oxidizer is excluded, and more specifically - air oxygen by means of foam, powder, sand, dense veil, carbon dioxide, etc.).

3. Cooling of the combustion zone with substances that take away part of the heat that goes to the burning continuation (in this method one of the most important sources of ignition is eliminated from three necessary and sufficient conditions for the occurrence and existence of fire, which we have enclosed in the scheme: it is achieved by the use of water, sand, carbon dioxide, etc.).

4. Dilution of gases reacting in the combustion process with gases that do not support combustion (water vapor, carbon dioxide, nitrogen). This method is based on the fact that the rate of the chemical reaction is less, the lower the concentration of the reacting substances

5. Chemical inhibition of the combustion reaction which can be achieved by using inhibitors-negative catalysts that reduce the reaction rate. Ethyl bromide (bromoethyl) is suitable for the purposes of extinguishing fires.

The primary fire extinguishers include fire extinguishers, asbestos cloth, water, sand, various powders, foam generators, special equipment, etc.

Incompatible fire sources and extinguishing means:

1. Wiring - water.

2. Light flammable and flammable liquids - water.

3. Alkali metals (interacting with water with explosion) – water.

Fire prevention rules:

1. Maintain self-control, the ability to quickly assess the situation and make right decisions. Strive to suppress confusion and panic in yourself and others.

2. It is necessary to leave the building immediately, using the main and emergency exits, external and internal staircases, improvised means (for the lower floors bed sheets, curtains, etc. are suitable). Do not use the lift! (because whoever started to extinguish is obliged to disconnect the power supply of the burning building). Modern lifts are connected with fire alarms. When they receive a signal, they must automatically go down to the first floor and not answer calls.

3. Call firefighters (name the exact address, your surname, arrange a meeting of the arriving units), inform the others.

4. If the fire is small, try extinguishing it with available tools before the fire brigade arrives.

5. Passing through burning rooms, cover the whole body with wet cloth (coverlet, plaid, blanket, etc.), through smoky rooms move crawling or crouching - there is less chance to suffocate in the smoke.

6. If your clothes catch fire, do not try to escape, but try to knock down the flames rolling on the floor; use water, snow, soil to extinguish.

7. For protection against combustion products, use personal protective equipment, including improvised means. (Carbon monoxide is insoluble in water (therefore protection with damp cloth does not help), it is not absorbed by the filter-absorbing box of a civil gas mask.)

8. When you leave the building on a smoky staircase, move along the wall.

9. Before opening the door to a smoky or burning room, stand on the side of it under the protection of the wall or partition and carefully open it.

10. If the electrical wiring is on, disconnect it.

11. Seek out the injured children in secluded places (under the bed, in the closet, etc.), call them.

Explosion protection

Explosion - the release of a large amount of energy in a limited amount in a short period of time. Explosions occur as a result of the release of various types of energy:

1. chemical (explosives, explosive mixtures (hydrogen with oxygen, for example, when charging batteries, wood or flour dust with air, paint and vapors, sugar dust, natural gas with air, etc.);
2. mechanical (the energy of compressed gases when the pressure limit is exceeded on the walls of the vessel or pipeline);
3. electromagnetic (spark discharge);
4. intranuclear (nuclear or thermonuclear explosions).

The peculiarity of the explosion as a phenomenon is a shock wave. The explosion leads to the formation of highly heated gas with very high pressure, which with instant expansion has a mechanical impact on the environment.

Defeating factors:

1. Shock wave.
2. Fragmented fields formed by flying fragments of various kinds of objects, technological equipment, construction parts, explosive devices, ammunition.
3. Exposure to high temperatures.
4. Collapse of structures and buildings.
5. The effect of radiation.
6. Secondary processes as a result of explosions – fires, electric shock, exposure to toxic substances, etc.

Consequences of explosions:

1. Bruises, fractures.
2. Craniocerebral injury.
3. Contusions.
4. Bleeding.
5. Burns of the body and respiratory tract.
6. Poisoning.
7. Radiation sickness.

8. Stress.

In cases of emergency occurring because of the explosion, act according to the following rules.

<u>In the case of explosion hazard:</u>

1. Prepare documents, valuables, clothes, medicines, food and drink.
2. Turn off the power supply (electrical appliances), gas, water.
3. Organized, without panic, leave the place of a possible explosion.
4. Do not inspect explosive objects on your own.

<u>After the explosion:</u>

1. If the building is damaged by an explosion, make sure that there are no significant damages to ceilings, walls, electric, gas and water lines.
2. Help victims.
3. Start to eliminate the consequences of the explosion.

If you are in the rubble:

1. Free yourself from the debris lying on you, and carefully examine yourself. (Touch your head, see if there is blood in your ears, take a deep breath - whether your chest is intact, try raising your legs.)
2. If there are no serious injuries, turn face down and try to move to a safer place. Strengthen your shelter with fragments of stones, exclude movement of plates, unbend sharp pieces of armature.
3. In whatever condition you are, try to let somebody hear - knock on pipes, fittings, etc.
4. Find the source of air intake; expand and strengthen the way to it (Air consumption per breath: 1 person – 1 m^3/hour).
5. Do not lose hope of salvation; hold out until the arrival of rescuers! Even in the most difficult obstructions people remain alive.

Electric shock

The outcome of an electric shock depends on various causes, many of them are not yet sufficiently investigated. Among the most important factors are the following:

- ➢ parameters of current and electrical circuit – the nature of the current, type of current, frequency, voltage magnitude;
- ➢ conditions of defeat - the place of contact, the current path in the body, the time of its action;
- ➢ physiological and psychological state of the body at the time of injury – skin moisture, sex, age, illness, fatigue, loss of attention;
- ➢ environmental factors – temperature, humidity, atmospheric pressure, partial air composition, electric and magnetic fields, air pollution.

The first and effective help to a person who is under current is to quickly break, de-energize the electrical circuit:

- ➢ disconnect the power source if the automatic starter, switch or plug with socket is within arm's reach;

➢ discard the wires from the victim by any non-conductive object;
➢ pull the victim by his clothes.

There are four degrees of electrical injury:

1 degree – the victim has convulsive muscle contraction without losing consciousness;

2 degree – convulsive muscle contraction in the affected person is accompanied by loss of consciousness;

3 degree – the victim has not only loss of consciousness, but also violation of cardiac activity and breathing;

4 degree - the victim is in the state of clinical death.

The most frequent causes of death in case of electric shock:

➢ Sudden cardiac arrest (ventricular fibrillation) – 80%
➢ Edema of the brain – 15%
➢ Spasm of respiratory musculature and asphyxia (suffocation) – 4%.
➢ Damage to internal organs, bleeding and burns – 1%.

Initiate first aid should only be after eliminating the danger of electric injury to others.

When the victim was released from electrical contacts, he should be examined immediately, checked for breathing, cardiac activity and measured vital signs, and provided with fresh air; unbutton the collar and waistband of trousers or skirts, other tightening garments, put on a flat place.

If the heartbeat and breathing (even weak) are preserved, you can give inhale ammonia, you should sprinkle face with cold water, rub the body with cologne, warmly wrap the affected person, immediately call a doctor.

With the saved consciousness, you can give painkillers, soothing and cardiac remedies. On the skin affected by electric burn, a bandage is applied, preferably from a sterile bandage moistened with diluted alcohol.

If there are severe disorders of breathing and cardiac activity, and even when they stop completely, proceed to artificial lung ventilation and indirect heart massage immediately, without losing a minute. For this:

➢ place the victim on a flat, hard surface;
➢ to release the respiratory tract from the tongue-swallowing, to throw back the head laying under the neck a bolster from clothes;
➢ raise the victim's legs upward to obstruct the flow of blood to them;
➢ cool the victim's head (if it is possible to cover the head with snow packs or ice packs) to reduce the edema of the brain;
➢ cause a precordial stroke;
➢ proceed to artificial respiration and indirect heart massage.

Answer these questions:

1. Give the definition of technogenic hazards.
2. Where does radiation exposure come from?
3. The most frequent causes of death in case of electric shock.
4. List the fire prevention rules.

Topic: Threat of a terrorist act
Goal: to learn safety rules in case of the threat of an act of terrorism
Plan:
1. Definition of Terrorism
2. Rules of conduct in case of detecting an explosive object.
3. Rules of conduct in case of receiving a phone message about the threat of a terrorist act.
4. Recommendations on the behavior of people in case of their capture as hostages.

Definition of Terrorism

Terrorism is, in the broadest sense, the use of intentionally indiscriminate violence as a means to create terror among masses of people; or fear to achieve a financial, political, religious or ideological aim.

Nowadays Extremism and Terrorism are the most serious threats in the modern world. Extremism is commitment to extreme views and, in particular, to measures. Among such measures one can note provocation of riots, civil disobedience, terrorist actions, methods of partisan warfare. And attachment "religious" implies adherence to any religion.

The most important condition for struggling against terrorist threats is intransigence, determination and rigidity of the response to the threat of terrorism.

The direct commission of a terrorist crime in the conditions of the technosphere is possible in the following forms:

- capture, damage or destruction of the economy, transport, etc.;
- organization of explosion and arson or the use of radioactive, biological and chemical agents;
- causing damage to life, health or property of people by creating conditions for accidents of anthropogenic nature;
- other actions that endanger people's lives and cause significant material damage.

The types of means used in the organization of terrorism are the following:

- nuclear terrorism, in which the largest scale source of crime can be the volumes of the nuclear industry and nuclear power plants, as well as the disposal of radioactive waste.

- chemical terrorism, in which many industrial and domestic toxic substances can be used.

- biological terrorism is the most dangerous type of terrorism. To detect the use of dangerous biological substances can only be after the onset of the disease, which takes days or weeks. The places of chemical and biological terror can be infrastructure facilities with a large number of people: metro stations, airports and railway stations, large office buildings, shops and supermarkets, closed sports and concert halls, the water supply system of big cities, food lots;

- technical terrorism – damage to economic objects, transport, hydraulic structures, etc., which can lead to the release of substances and energy, significantly more dangerous than their primary impact. This is the case with the destruction of buildings and structures, oil and gas storage facilities, dams, bridges, etc.
- information terrorism – an attack on computer networks. The most vulnerable are telecommunications, aviation dispatching, financial and government information systems, computer networks in the energy sector, and automated control systems in the armed forces.

A set of measures aimed at countering terrorism at economic units:

- legal – bringing requirements of laws and regulations to the site personnel;
- information – issuance of orders, insructions to observe the established rules, appointment of responsible persons for carrying out protective measures;
- technical – installation of alarms, audio, video recordings, barriers, car parking places not closer than 100 m from the places of mass stay of people, etc .;
- organizational – determining the scope of preventive measures; appointment of a set of persons responsible for compliance with the access regime, bypassing the site territory, etc.; verification of incoming property; carrying out of careful selection of employees, especially in protection subdivisions, service personnel (persons on duty, repairmen, cleaners, etc.); drawing up instructions; organization of personnel training and planning its actions in the case of the threat of terrorist attacks.

In Kazakhstan the system of measures to ensure security of the society and the state from terrorist threats has been developed and gradually improved that has allowed to accumulate certain experience in identifying and suppressing the activities of terrorist organizations.

Rules of conduct in case of detecting an explosive object

<u>Signs of the presence of explosive devices:</u>

1. Cars parked near houses, unfamiliar to tenants (ownerless).
2. The presence of wires, a small antenna, tape, tape on the machine or some household item (bag, suitcase, box, etc.).
3. Unusual placement of the found household obsolete item.
4. Ownerless portfolios, suitcases, bags, bundles, bags, boxes.
5. The presence of noise inside the detected object (ticking of the clock, clicks or any other sounds).
6. The presence of power sources in the found object (batteries).
7. Stretching of wire, twine, rope.

8. Specific smell, not peculiar to a particular area.

Possible locations for installation of explosive devices:

1. Underground transitions (tunnels).
2. Stations, markets, shops.
3. Stadiums, discos.
4. Means of transport.
5. Life support facilities (power plants, gas pumping stations and distribution stations).
6. Educational institutions.
7. Hospitals and polyclinics.
8. Cellars, attics and staircases of residential buildings.
9. Containers for garbage, urns.
10. Supports of bridges and power lines.

When suspicious objects are detected, it is strictly forbidden:

- to touch, open and move the object;
- to use found unfamiliar objects;
- to move from place to place, roll things from place to place, pick them up;
- to lift, carry over, put in pockets, briefcases, bags, etc.;
- to bury them in the ground or throw them into ponds;
- to break or pull the wires of objects, to make attempts to neutralize them;
- to use electric and radio equipment near this object, especially key fobs of car alarms, radio stations, radiotelephones, mobile phones;
- to search for other suspicious or explosive objects before the arrival of specialists.

If you find a suspicious object, try to determine to whom it belongs or who could leave it. If the owner is not found, immediately report the found item - first to the special services officers, the driver (if the object is found in the car, bus, other modes of transport), the head of the institution (if the object is found in the institution). Remember the time of detection, try to take measures to ensure that people are as far away from it as possible. Do not touch, do not open or move the object, do not let others do it. Wait for the arrival of police officers.

Rules of conduct in case of receiving a phone message about the threat of a terrorist act

Law enforcement authorities will greatly help to prevent the commission of crimes and tracing criminals following your actions.

Try to memorize the conversation verbatim and write it on paper. During the conversation, note the gender, the age of the caller and the features of his (her) speech:

- voice: strong, still, base, high pitched;
- rate of speech: fast (slow);

- ➢ pronunciation: de-articulation, distorted, with stuttering, with stuttering lisping, with accent or dialect;
- ➢ manner of speech: cheeky, with mockery, with obscene expressions.

Be sure to note the sound background (noise of cars or railway transport, sounds of tele- or radio equipment, voices, etc.).

Note the nature of the call (city or long-distance). Be sure to record the exact time of the conversation and its duration.

In any case, try to get answers to the following questions during the conversation:

- ➢ Where, to whom, on which phone is this person calling?
- ➢ What specific requirements does he (she) put forward?
- ➢ Does he (she) put forward demands personally, acts as an intermediary or represents a group of persons? - On what terms does he or she agree to abandon the plan?
- ➢ How and when can you contact him (her)?
- ➢ To whom can you or should you inform about this call?

Do not spread the fact of the conversation and its content. Limit the number of people who know the information.

If there is an automatic number identification (ANI), write down the phone number in the notebook, which will prevent its accidental loss.

When using sound recording equipment, immediately remove the cassette (mini-disc) with the recording of the conversation and take measures to protect it. Be sure to replace it with another cassette.

Recommendations on the behavior of people in case of their capture as hostages

If you were taken hostage:

1. Calm down and do not panic. Speak in a calm voice.
2. Mobilize your forces and prepare for a possible ordeal.
3. Keep mental and physical activity.
4. Do not provoke terrorists: do not show hatred and disdain.
5. From the very beginning (especially in the first hour) follow all the instructions of the terrorists.
6. Do not attract terrorists by your behavior, do not give active resistance. This can aggravate your situation.
7. Try to define the place of your location (imprisonment).
8. Do not attempt to escape unless there is full confidence in the success of the escape.
9. Declare your unwell condition.
10. Do not neglect food. This will help to maintain strength and health.
11. Remember as much information as possible about terrorists (quantity, weapons, how they look, the features of negotiation, the manner of behavior).

12. If possible, try to stay away from windows, doors and terrorists. This is necessary to ensure your safety in case of assaulting building, shooting snipers to defeat criminals.

13. With possible assault on the building, lie face down on the floor with your hands clasped at the back of your head.

14. Remember, the law enforcement bodies are doing everything to free you.

If you are injured:

1. If there is capillary bleeding. Try to bandage the injury with tourniquet, towel, scarf or a piece of cloth.

2. If there is venous bleeding. Apply pressure bandage using strap, handkerchief, strip of durable fabric.

3. Help those who are near, but in a more difficult situation.

If you are gasping:

1. Wear a damp cotton-gauze bandage.

2. Protect respiratory organs with a wet towel, handkerchief, scarf or other cloth.

3. If you smell gas, open windows, do not use a cigarette lighter, matches, do not turn on electrical appliances and lighting.

Answer these questions:

1. What is terrorism?
2. What are the main types of terrorism?
3. What measures of protection against terrorism are known to you?
4. List signs of the presence of explosive devices.
5. Your actions if you are in the rubble.
6. Your actions if you are gasping.

Topic: The existence of man in extreme natural conditions

Goal: to study the main problems solved in conditions of forced autonomy

Plan:

1. Autonomous survival in extreme environmental conditions
2. Overcoming fear and possible stress
3. Establishing communication or giving distress signals.
4. Getting food
5. Shelters
6. Bonfires

Autonomous survival in extreme environmental conditions

Man evolved the significant period of his history exclusively in natural conditions; has acquired experience, knowledge, ways and methods of existence in various and sometimes very severe natural conditions. Thanks to technical progress man created an artificial habitat which guarantees him a relatively safe and comfortable existence. However no matter how perfect, automated, informative this comfortable world is, the man always exists in it only at the expense of nature, its resources. Contacts with nature are inevitable - sometimes in a soft, sometimes in a rigid form, including extreme situations.

Extreme situation is the situation that has a direct threat to life, human health or property and at the same time it is limited or excluded the possibility of assistance from other people.

Extreme situations occur more often when a person is forced to stay at a considerable distance from the inhabited place. Prerequisites for such situations can be:

- sudden changes in weather conditions;
- disaster;
- exaggeration of one's own capabilities in a difficult situation;
- insufficient qualification of a specialist;
- loss of orientation;
- failure of machinery, transport;
- harassment of the enemy, etc.

In all cases, when a person changes his location, he is forced to learn new climatogeographical conditions of life and habitat.

Adaptation to new climatogeographical conditions of life is called acclimatization and is carried out in a complex way in several directions:

1. Acclimatization to the changes in the temperature regime.
2. Acclimatization to the changes in the solar (radiation) regime.
3. Acclimatization to the change in the daily regime.

The favorable outcome of autonomous existence largely depends on the psychophysical qualities of a person, physical readiness, endurance, etc.

Survival means active, expedient actions aimed at preserving life, health and efficiency in an autonomous existence.

In conditions of forced autonomy a person is rarely closed in an enclosed space. And if this happens, we must take into account that 1 person for 1 hour requires 1m^3 of air.

The problem of water has two sides. This is, first, reducing water use and keeping it in the body in every possible way, and, secondly, searching for sources of water and preparing it for use.

The minimum water intake necessary to maintain the water balance in the body is approximately 1,1 liters. The daily loss of water by a person equal to 1,5 liters is distributed as follows: urine 0,5 l; sweat 0,5 l; loss of breath 0,4 liters; feces 0,1 liters. Losses of water sharply increase in cases of vomiting (seasickness, food poisoning, trauma accompanied by concussion), diarrhea related to person's sick condition. The use of alcoholic beverages also causes dehydration of the body.

The daily compensation for water losses consists of the following sources:

- ~1,1 liters of water, drinks, juices, tea, soups, water contained in solid foods (vegetables, bread (~ 35%)), etc .;
- metabolic water (with the intake of 100 g of fat as a result of metabolism 107 ml of water is formed, 100 g of carbohydrates – 55 ml of water, 100 g of protein – 41 ml of water).

Water sources:

1. Spring, stream, river, soil water.
2. Lake, swamp, puddle.
3. Precipitation (rainwater, dew, frost, snow, ice).
4. Plant juice, animal blood.
5. Wells.
6. Condensate.

Water purification:

1. Filtration (a layer of soil, sand, charcoal, cloth).
2. Decontamination (boiling, addition of potassium permanganate ($KMnO_4$) to slightly-pink color, followed by sedimentation and filtration of a dark precipitate (MnO_2), 2-3 drops of 5% solution of I_2 per 1 liter of water, 1-2 tablets of lanthocide per 1 liter of water, boiling for 30-40 minutes with 100-150 g of young branches of coniferous trees, birch bark, bark of oak, willow on a bucket of water). These methods can not purify water from pesticides and chemical fertilizers.

In conditions of forced autonomy four cases of starvation may occur:

- absolute (or dry, since no food and water);
- complete (no food, but enough water);
- incomplete (eating food in limited quantities, not enough to fill energy losses);

➢ partial (with sufficient food, a person loses with food one or several substances necessary for the body, for example, vitamins).

The possibilities of starvation depend on many factors and fluctuate in a large time interval for people of different ages, complexion and state of health.

Before going into starvation it is necessary to assess the current situation and make a strategy of behavior taking into account the gained experience:

➢ 2-3 days of starvation when drinking water does not affect the body condition negatively.

➢ Avoid sharp transition to starvation, it is better to gradually reduce the amount of food consumed and its calorie content. But, if you went into starvation, it is better not to eat at all, than to use fractional food.

➢ With decrease in nutrition, drink more water (preferably warm), this is especially important in the first days of fasting, when the body loses a lot of fluid.

➢ Minimize energy losses – maximally reduce motor activity, lie more; keep the body warm. (Warm clothes, hat, mittens.)

➢ The critical state occurs on the 30^{th}-40^{th} day.

Any forced autonomy immediately puts before the person tasks, from the solution of which, in the first place, depends its outcome:

➢ overcoming fear and getting out of a possible stressful state;
➢ assistance or self-help in the event of injury;
➢ salvage of property and water and food supplies;
➢ establishing communication or distress signals;
➢ obtaining water and food;
➢ construction of temporary shelters;
➢ preservation of life and health;
➢ orientation in space and time, determining the route to people.

Overcoming fear and possible stress

Fear is the first reaction of a person caught in an extreme situation. This is a natural reaction to danger, and it is typical for any normal person. It is fear for life that causes the desire to act to be saved, and if a person knows what he should do, fear intensifies reaction, activates thinking.

There are several grades of fear:

➢ fright (the first reaction to the threat),
➢ anxiety (a sense of uncertainty when expecting unfavorable events),
➢ fear (reacting to real danger),
➢ panic (uncontrollable animal fear).

Each individual has a limit of mental endurance, beyond which he is not capable of further resisting the feeling of fear, falling into chaotic behavior or some kind of stupor. Shock, arising from fear, usually lasts from 15 to 30 minutes.

Physiological symptoms of fear are: increased heart rate, trembling, weakness, muscle retardation, drying of the mouth and throat, sweating, nausea, dizziness, lack of air, rumbling in the abdomen, frequent urge to urinate, involuntary emptying of the intestine and bladder.

Stress is the state of strong nervous tension. It can be long and short-term. In the case of a long stress state, three phases can be distinguished:

- reaction of anxiety (the phase of mobilization of body defenses);
- stabilization phase;
- exhaustion.

Overcoming stress and fear:

- Auto-training. Even forcing yourself to count to 30 with your eyes closed, you can achieve the first result – to calm down. A good result is given by breathing exercises which are part of the warm-up complexes of many martial arts.
- Analysis of the situation and development of an action plan.
- Mobilization of consciousness and will on active actions.

Establishing communication or giving distress signals

The search for people who find themselves in an extreme situation is often hampered by the fact that it has to be conducted on a large territory. Therefore, those in distress must use any available means to provide a signal indicating their location

For this, various pyrotechnic means can be used: the combined signal cartridge, signal rockets, and etc. For radio signals, special emergency radio stations, small in size, can be used which, when switched on for three hours, give alarm signals.

The simplest ways of signaling:

➢ signalling mirror

➢ smoke of a fire

Mobile telephony belongs to the perfect technical means that can be used to overcome the misfortune of an autonomous existence.

Getting food

To get food in natural extreme conditions of survival is one of the main tasks, from the solution of which depends, first of all, the maintenance of human strength, the resistance of his organism to the harsh external environment.

Signs of plants edibility:

1. Fruits are bitten by birds.
2. Remains of plant food at the foot of trees and bushes (many pits, scraps of peel).
3. Bird litter on branches, trunks.

4. Plants gnawed by animals.
5. Fruits of plants found in nests and burrows.

Do not use:

1. Unfamiliar plants, berries, mushrooms.
2. Plants that produce milky juice at the break.
3. Berries and mushrooms with an unpleasant taste.
4. Bitter plants.

Edible parts of plants: tubers, roots and rhizomes, bulbs (under the ground, as a rule, are rich in starch, eaten raw, boiled or fried), shoots and stems, leaves, grain, bark (edible soft inner layer of bark of young birches and pines, cut as noodles, eaten both raw and dried), berries and fruits (the richest in vitamins and carbohydrates), nuts, mushrooms.

Burdock as a root crop can replace carrots, parsley, parsnips.

Great nettle is rich in proteins (vegetable meat). In the leaves of the nettle there is a lot of ascorbic acid, and vitamin K is more than in spinach and cabbage.

Dandelion regulates the activity of the gastrointestinal tract, eliminates the feeling of fatigue, both physical and mental, contains insulin.

Common borage contains ascorbic acid, carotene, aromatic substances; raises spirit, improves mood.

Sorrel contains vitamin C, rutin, potassium, iron, magnesium, tannins.

Berries of juniper contain up to 40% of sugar.

Among the representatives of the animal world grasshoppers, smooth caterpillars, larvae and pupae of bug beetles, spiders, termites, mollusks, snails, freshwater or sea crabs, crayfish, lobsters, shrimps, frogs, newts, salamanders, snakes, lizards, turtles, fish could be eaten. Hunting for fish, birds, animals requires skill and some equipment.

Shelters

After giving the distress signal, a temporary shelter should be built. As a rule, it is built from improvised means or natural materials. It must protect first of all from precipitation, scorching sun or cold, strong wind.

The most universal available means is the tent. Installed at a certain angle to the ground, it not only can protect against precipitation, but also become a reflector of the heat from the fire, which is an integral part of the temporary shelter.

In the cold season it is possible to arrange lodging for the night on the site of a campfire on warmed land. It is better to make litter from branches of coniferous trees or dry leaves. If it is dangerous to sleep on the ground, it is necessary to make the place to sleep on a tree.

After the shelter is built, you need to take care of the fire. Matches should always be kept in a plastic bag. If they are still wet, but not deoxidized, they can be dried in the hair under the headdress.

The key to any good fire is a quick start.

Good tinder - small dry shavings or strands or globs or drippings of quickly combustible material used to start a fire - is critical.

Tinder is usually dry sticks and twigs that can usually be collected on the ground, or in wet country, from downed and dead branches and trees. It's often called "squaw wood" inferring it can be gathered without tools and much effort.

All fires are not the same; they can be built for specific purposes, to accent either heat or light, and can be constructed so as to radiate heat in a certain direction (fig. 11).

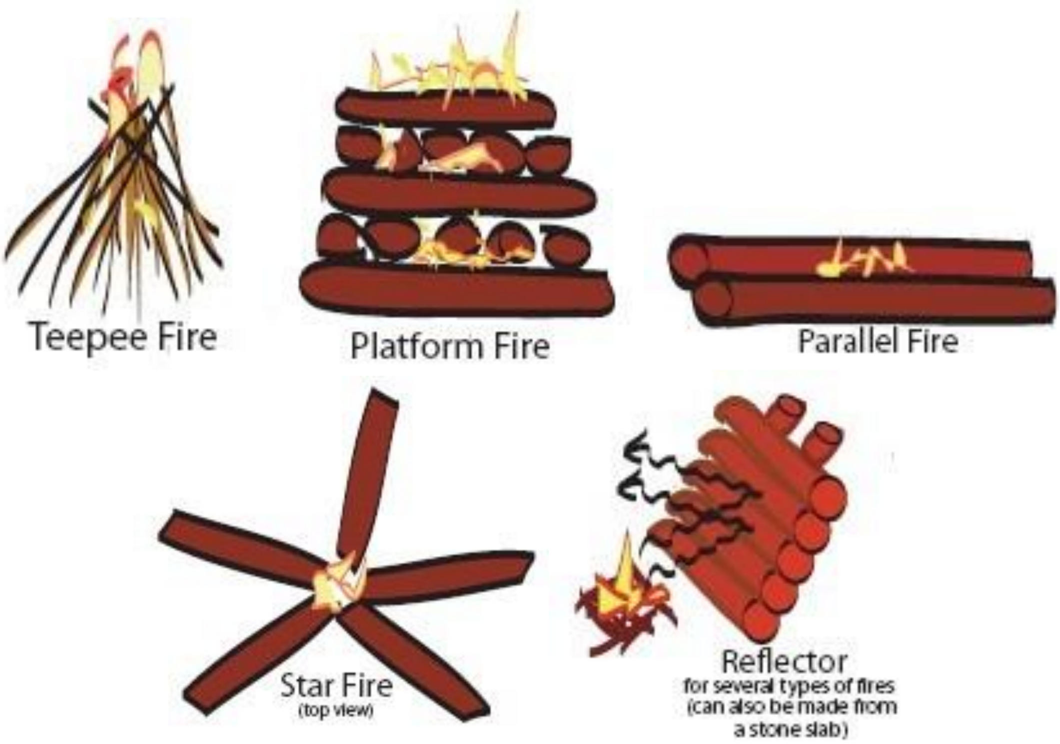

Figure 11 - Types of Campfires

Teepee fire. This is probably the most basic of fire designs. It is often used as a starter upon which bigger, longer-lasting fires are founded. It's also a great fire for a quick warm-up or water-boiling snack break. A teepee fire is a good fire to direct heat upward and can be used beneath a hung pot on a tripod for fast heating.

Pyramid/platform fire. This fire consists of a foundation framework of large logs laid side by side to form a solid base. A slightly shorter log is laid perpendicular and on top of this first layer. Each subsequent layer is slightly shorter as the platform or pyramid rises. This solid mass of right angle firewood takes a little effort to light but it's well worth it for the huge amount of coals it produces, especially when the fire is lit on the top most layer and burns down through the layers.

Parallel fire. Sometimes a fire is build between two long logs. If the logs are the same size, the tops of the log can be used to place pots for cooking. It has the added advantage of prolonging the fire since the insides of the log are burning too, and its easy to direct the fire up or down the length of the side log, literally until the entire log eventually consumed. A similar fire is the trench fire, used almost exclusively for cooking. These work by either blocking the wind or in funneling the wind into the fire for a more concentrated and hotter "burn". Several pots can be placed over the trench and the fire can be maintained at different levels for a variety of cooking options.

Star or Indian fire. A star fire, or Indian fire, is the fire design often depicted as the campfire of the old West. Imagine five or six logs laid out like the spokes of a wheel (star shaped). A fire is started at the "hub" and each log is pushed towards the center as the ends are consumed. It's another fire that can be kept burning all night long with little maintenance.

Reflector fire. A reflector fire is really any fire that has some sort of flat surface behind it to direct the heat back out past the fire. This surface is erected behind the fire and pointed, for example, at the face of a tent, lean-to or other shelter. This back reflector can be made out of a few large slabs of bark, several logs laid against supports and stacked upon each other to form the surface. Rocks can also be used but just like those used to ring a fire, make sure they do not contain moisture. That trapped moisture can be heated to where it's like a steam engine with no release valve. Exploding rocks can send shrapnel and shards flying in every direction!

Answer these questions:

1. What is an extreme situation?
2. What are the preconditions for an extreme situation?
3. How is the daily loss of water distributed?
4. Name the sources of water.
5. Name the stages of fear.
6. Stages of overcoming stress and fear.
7. The simplest ways of signaling.
8. Name the signs of edible plants.
9. Name the types of bonfires.

Topic: First-aid dressing
Goal: to develop skills of first aid with various injuries
Plan:
1. Concept of trauma
2. First aid for injuries
3. First aid for burns
4. First aid for contusion
5. First aid for dislocation
6. Elongations and ruptures of ligaments
7. First aid for poisoning
8. First aid for drowning
9. First aid for heart failure
10. First aid for animal bites

Concept of trauma

Trauma - an anatomical or physiological disorder of the body, caused by the external factor. Traumas are divided into mechanical, physical, chemical, biological and mental.

Mechanical injuries are open (wounds), which occur with violation of cutaneous or mucous membranes, and closed – without damaging them. Closed injuries include bruises, ruptures of internal organs (spleen, liver, kidneys, intestines, etc.) and damage to the skeleton: fractures of bones and dislocations.

Physical injuries occur in case of high or low temperatures (burns, heat stroke, frostbite, etc.), electric current (electric trauma, lightning) and radiation energy (sunburn, radiation sickness).

Chemical injuries are caused by acids, alkalis, poisons, poisonous substances.

Biological traumas are caused by the action of bacterial toxins.

Psychic traumas are the result of reflex stimulation of the central nervous system by strong or unexpected stimuli (for example, fright).

First aid for injuries

Injury is an open lesion with violation of the integrity of the skin or mucous membranes, and sometimes deeper tissues as a result of mechanical action.

Depending on the hurt object, injuries are divided into cut, stab, chopped, bruised, ripped, etc. Injuries with violation of the cavity (thoracic, ventral, skull or joints) are called penetrating. They can be with the prolapse of internal organs.

Symptoms of injury: pain, diverging wound edges and bleeding.

First aid:

- ➢ bleeding stop
- ➢ protection of the injury from secondary infection
- ➢ easing of pain.

Bleeding:

Arterial bleeding occurs when the arteries are damaged. The blood flows out in a pulsating stream of crimson color. Wounds of large arteries (femoral, humeral) are always dangerous for life.

Venous bleeding is formed when a large vein is injured and is characterized by a slow calm stream of dark cherry color. When injuring the cervical veins, air is often sucked in, which, causing the blockage of blood vessels, can lead to death.

Capillary bleeding accompanies the wounding of the smallest blood vessels. The blood oozes on the entire damaged surface. Bleeding from capillaries and small vessels stops spontaneously.

Methods of temporary stop bleeding:

1. giving the affected organ (limb) an elevated position (relative to the level of the heart)
2. clamping of vessels – in the wound with the help of pressure bandage; flexion of the limb; finger pressing; application of hemostatic tourniquet.

Errors when applying tourniquet or twist:

- ➢ applying tourniquet without sufficient indications;
- ➢ applying tourniquet to the exposed skin;
- ➢ wrong choice of the location of the tourniquet;
- ➢ wrong degree of its tightening;
- ➢ absence of the note on the time of its application;
- ➢ delay with the evacuation of the victim.

Injury infection control is conducted by aseptic and antiseptic methods.

Aseptics is a set of measures aimed at eliminating germs before they enter the wound.

Antiseptics is a set of methods and ways aimed at weakening or complete elimination of microbes in the wound:

- ➢ mechanical – removal of fragments of object, scraps of clothing, soil, etc. on the wound surface with the help of gauze;
- ➢ physical – the difficulty of penetration of microbes into the depths of tissues in the case of application of the aseptic hygroscopic cotton-gauze dressing;
- ➢ chemical – filling the wound surface with penicillin or sulfonamide powder;
- ➢ biological - the use of tetanus antiserum, etc.

Most bleeding occurs from the front of the nose and does not pose a serious threat. Bleeding from the back of the nose is dangerous because the blood can get into the throat and cause nausea and choking. Therefore, the advice to tilt your head back and lie on your back - are questionable.

First aid:

1. It is better for the victim to sit, slightly bending forward, slightly tilting his head and opening his mouth – so that he can breathe freely.

2. It is better to breathe through the nose - the incoming air will dry the blood and speed up its clotting.

3. Strongly, but gently squeeze the nose from both sides under the cartilage with the thumb and forefinger. Put cold compress on the top of the nose. Use pressure and compress continuously for 6-8 minutes.

4. Natural remedies: put the tampon steeped with the solution of vinegar, yarrow solution or juice, shepherd's purse with little water.

Internal bleeding occurs in the case of rupturing an artery, vein, capillaries or the combination of these causes. They appear in the form of bruises and hematomas.

Symptoms of internal bleeding:

- coffee-ground vomit;
- dark or red urine;
- blood-red or black feces;
- vacillating, too slow or too fast pulse;
- feeling of anxiety, fear;
- paleness, cold and damp skin, dizziness, weakness;
- distended, swollen or hard abdomen, pain in the abdomen.

First aid for internal bleeding:

1. Control the victim's breathing and pulse.
2. Unbutton the clothes, look for other possible injuries.
3. Complete rest to the victim.

First aid for burns

Burns are a global public health problem, accounting for an estimated 180 000 deaths annually. Burns occur mainly in the home and workplace.

Burn is an injury to the skin or other organic tissue primarily caused by heat or due to radiation, radioactivity, electricity, friction or contact with chemicals.

Thermal (heat) burns occur when some or all of the cells in the skin or other tissues are destroyed by:

- hot liquids (scalds)
- hot solids (contact burns)
- flames (flame burns).

Depending on the depth of skin damage there are four degrees of burns:

First-degree burn is accompanied by redness, swelling and soreness of the affected areas (pass through 2-3 days).

At the second-degree burn on the red edematous skin appear bubbles filled with clear or unclear fluid (the healing lasts 5-6 days or more).

Third-degree burn is characterized by the necrosis of all layers of the skin with the formation of the scab resulting from the coagulation of proteins.

For the fourth-degree burn the characteristics are the necrosis of the skin and deeper lying tissues and sometimes their incineration. Burn shock develops as a result of absorption by the body of the products of decay of tissues from the affected areas.

First aid for burns:

What to do:

- Stop the burning process by removing clothing and irrigating the burns.
- Extinguish flames by allowing the patient to roll on the ground, or by applying a blanket, or by using water or other fire-extinguishing liquids.
- Use cool running water to reduce the temperature of the burn.
- In chemical burns, remove or dilute the chemical agent by irrigating with large volumes of water.
- Wrap the patient in a clean cloth or sheet and transport to the nearest appropriate facility for medical care.

What not to do:

- Do not start first aid before ensuring your own safety (switch off electrical current, wear gloves for chemicals etc.)
- Do not apply paste, oil, haldi (turmeric) or raw cotton to the burn.
- Do not apply ice because it deepens the injury.
- Avoid prolonged cooling with water because it will lead to hypothermia.
- Do not open blisters until topical antimicrobials can be applied, such as by a health-care provider.
- Do not apply any material directly to the wound as it might become infected.
- Avoid application of topical medication until the patient has been placed under appropriate medical care.

First aid for contusion

Contusion – closed damage to soft tissues and blood vessels with the formation of bruises. They arise when you strike against a solid blunt object.

Symptoms: pain, usually small, occurs at the time of the impact or soon after, but with a bruise of the abdomen and testicles, it can be marked up to a painful shock.

The first aid is aimed at reducing hemorrhage and pain relief. To stop internal bleeding it is necessary to apply the pressure bandage, attach an elevated position and cool the place of the injury.

First aid for dislocation

Dislocation - persistent abnormal displacement of the ends of bones that form part of any joint, which occurs when the joint bag is ruptured. Most often occur in the shoulder, less often in the hip, ankle and elbow joints as a result of unsuccessful fall or injury.

Symptoms: pain; the limb function is broken; normal movements in the joint are impossible; forced typical limb position; the joint is deformed; the limb is shortened or elongated; resilient fixation of the joint.

The first aid is to reduce pain and delay development of edema. Natural remedies: make a poultice or compress with comfrey. You cannot try to set the sprains yourself!

Elongations and ruptures of ligaments

Sprains and ligament rupture of the joints arise as a result of sudden and rapid movements that exceed the physiological mobility of the joints, which entails a different degree of tearing of the joint bag or ligaments. Most often suffer ankle, wrist, knee joints.

Symptoms: pain in joint during movement, swelling, in case of rupture of ligaments - bruise; the victim with difficulty but can use the limb.

The first aid is a tight bandage by applying pressure bandage, cold compress, rest of the limb.

First aid for poisoning

Food poisoning can be caused by collibacillus, botulinum wand, salmonella, staphylococcus, etc.

It is necessary to assume food poisoning if the victim used food of unknown origin, ate food with some strange taste, or when several people ate the same thing and felt bad.

The most common symptoms of poisoning are diarrhea, vomiting, and stomach pain. The main risk in this situation is dehydration caused by diarrhea and vomiting. Usually occurs self-healing for 1 to 2 days.

The first help is important if the symptoms develop dramatically, increase, with breathing difficulties and acute pain in the abdomen:

1. Consumption of food at this time usually worsens the condition and it should be refrained.
2. Do not allow dehydration, compensate for fluid and electrolyte losses.
3. Natural remedies: take charcoal or food clay, thistle seeds or extract from them, garlic or extract from it, tea from plantain, dandelion roots. The extract from the thistle seeds helps the liver cells recover, strengthens the body's ability to purify blood and decompose toxins.

First aid for drowning

Drowning is the 3rd leading cause of unintentional injury death worldwide, accounting for 7% of all injury-related deaths. There are an estimated 360 000 annual drowning deaths worldwide.

Drowning - closing of the respiratory tract with water, mud, silt or sewage. The cause of death depends on the nature of the drowning. Reflex paralysis of the heart – "death in water" – arises from sudden irritation with cold water of the nerve endings of the skin and larynx or in emotional shock from fright. In these cases there are no phases of body protection that are characteristic for drowning - the skin and mucous membranes of dead are deadly pale, and in the lungs they do not have water.

The blockage of the respiratory tract by water in large reservoirs occurs with fatigue or in the unconscious state. The tired person does not sink at once, at first in a panic he makes uncoordinated movements and, getting out of his strength, plunges into the water holding his breath. In the water after 1 - 1.5 minutes he takes an involuntary deep breath and the lungs are filled with water. Then involuntary shallow respiratory movements appear in the lungs, as a result of which the foam is formed from the water, mucus and remaining air. It is resistant enough even when it dries. Breath stops, but the oxygen in the blood still supports the vital activity of the cells. After 1-1.5 minutes after the cessation of breathing, brain cells are damaged and the person loses consciousness. And after 1.5-2 minutes the heart stops. Having lost consciousness in water, the victim quickly sinks while the respiratory movements do not stop until the agony.

Symptoms. In cases of blockage of the respiratory tract by water, the skin and mucous membranes of the victim are sharply cyanotic, ears, lips and fingertips are of violet-blue color. The visible veins of the head and neck are sharply swollen. The face is puffy. There is a lot of foam with admixture of blood from the mouth and nose.

The first aid is aimed at pulling the victim out of the water and reviving him. If the victim who swallowed the water is conscious, he must be undressed, wiped dry, wrapped and warmed. In this case, it is advisable to induce vomiting by irritation of the root of the tongue and the posterior pharyngeal wall.

In the absence of consciousness of the drowned person it is necessary to cleanse the mouth and pharynx from mucus, mud and sand and immediately to begin resuscitation.

First aid for heart failure

The causes of cardiac arrest (circulation) are: heart disease – myocardial infarction; primary respiratory distress; external factors – mechanical or electrical injuries, poisoning; acute progressive disorder of the internal environment of body (electrolyte, metabolic, etc.). Regardless of causes and type of circulatory arrest, clinical death comes from cessation of oxygen supply to the tissues.

Symptoms: skin is pale gray with cyanotic colour, no consciousness, pupils are dilated and do not react to light, the pulse on carotid and femoral arteries is not probed or only rare weak waves are noted, no breath or there are separate rare flanks.

The first aid is aimed at providing organs and tissues with oxygenated blood, and restoring sustained blood circulation.

Resuscitation (reanimation) – a series of activities aimed at restoring the life of patient whose breathing and circulation suddenly stopped. It includes artificial respiration, providing cerebral circulation sufficient to prevent irreversible changes in the brain cells.

First aid for animal bites

Animal bites pose a serious threat to health of children and adults. The health impacts of animal bites are dependent on the type and health of the animal species, the size and health of the bitten person, and accessibility to appropriate health care.

Numerous animal species have the potential to bite humans; however the most important are those arising from snakes, dogs and cats.

Snake bites

Worldwide, up to five million people are bitten by snakes every year. Of these, poisonous (envenoming) snakes cause considerable morbidity and mortality. There are an estimated 2.4 million envenomations (poisonings from snake bites) and 94 000–125 000 deaths annually, with an additional 400 000 amputations and other severe health consequences, such as infection, tetanus, scarring, contractures, and psychological sequelae. Poor access to health care and scarcity of antivenom increases the severity of the injuries and their outcomes.

Approximately 600 species of snake are venomous and approximately 50-70% of bites by these cause envenomation. At the time of a bite, the cornerstone of care is complete immobilization of the affected body part and prompt transfer to a medical facility.

Tourniquets and cutting wounds can worsen the effects of the venom and should not be used as first aid.

Frequently, victims of snake bites will require treatment with antivenom. It is important that the antivenom is appropriate for snakes endemic to the region. Additional measures include wound cleansing to decrease infection risk, supportive therapy such as airway support, and administration of tetanus vaccine upon discharge if the person has been inadequately vaccinated against tetanus.

Prevention of snake bites involves informing communities about snake bite risks and prevention techniques, such as to:

- avoid tall grassy areas;
- wear protective shoes/boots;
- keep storage areas clear of rodents;
- remove rubbish, woodpiles and low brush from around the home;

• store food in rodent-proof containers, raise beds above floor level and tuck mosquito nets securely under sleeping mats within the home.

Dog bites

There are no global estimates of dog bite incidence, however studies suggest that dog bites account for tens of millions of injuries annually.

Who is most at risk?

Children make up the largest percentage of people bitten by dogs, with the highest incidence in mid-to-late childhood. The risk of injury to the head and neck is greater in children than in adults, adding to increased severity, necessity for medical treatment and death rates.

Treatment depends on the location of the bite, the overall health condition of the bitten person and whether or not the dog is vaccinated against rabies. The main principles of care include:

• early medical management;
• irrigation and cleansing of the wound;
• primary closure if the wound is low-risk for developing infection;
• prophylactic antibiotics for high-risk wounds or people with immune deficiency;
• rabies post-exposure treatment depending on the dog vaccination status;
• administration of tetanus vaccine if the person has not been adequately vaccinated.

Cat bites

Worldwide, cat bites account for 2–50% of injuries related to animal-bites. They are commonly second to dog bites in terms of incidence.

Who is most at risk?

Female adults have the highest rate of cat bites.

Treatment depends on the location of the bite and the rabies vaccination status of animal species inflicting the bite. The main principles of care include:

• early medical management including wound cleansing;
• prophylactic antibiotics to decrease infection risk;
• rabies post-exposure treatment depending on the animal vaccination status;
• administration of tetanus vaccine if the person has not been adequately vaccinated.

Answer these questions:

1. What is a trauma?
2. Give an example of chemical trauma.
3. Give an example of physical trauma.
4. First aid for internal bleeding
5. What is resuscitation?

CONCLUSION

The aim of the authors of the textbook was to present a course of lectures in English for students studying the discipline "Ecology and life safety basics". The textbook is written on the basis of lectures and focuses on the main branches of the general ecology and life safety basics.

The textbook is intended to solve such problems as formation of knowledge about the basic laws of sustainable development of nature and society, possible dangers not only of the natural environment, but also of the technosphere. It is important to have the ability to recognize the nature of certain negative environmental factors, to identify and implement the necessary set of measures to prevent their adverse effects on the human body and health.

The textbook consists of 11 lecture topics with a goal, plan and control questions. For better understanding of the material the textbook has some illustrations, tables, examples. At the end of the textbook the references, as well as a glossary of terms and vocabulary are given.

The textbook is recommended for organization of the educational process in conducting lectures on the course "Ecology and life safety basics".

The textbook is intended for students, and can also be useful for a wide range of teachers and specialists in other areas interested in the basics of ecology and life safety.

GLOSSARY

A

Abiotic	Nonliving. Compare biotic.
Abundance	The total number of individuals, or biomass, of a species present in a specified area
Adaptation	1. Any genetically controlled structural, physiological, or behavioral characteristic that helps an organism survive and reproduce under a given set of environmental conditions. It usually results from a beneficial mutation. See biological evolution, differential reproduction, mutation, natural selection. 2. An evolutionary process that changes anatomy, physiology, or behavior, resulting in an increased ability of a population to live in a particular environment. The term is also applied to the anatomical, physiological, or behavioral characteristics produced by this process.
Age structure	Percentage of the population (or number of people of each sex) at each age level in a population
Agriculture	The growing of crops and livestock for human consumption.
A horizon	A biologically active soil layer consisting of a mixture of mineral materials, such as clay, silt, and sand, as well as organic material, derived from the overlying O horizon; generally characterized by leaching.
Air pollution	One or more chemicals in high enough concentrations in the air to harm humans, other animals, vegetation, or materials. Excess heat is also considered a form of air pollution. Such chemicals or physical conditions are called air pollutants.
Altitude	Height above sea level. Compare latitude.
Anthropocentric	Human-centered
Aquatic life zone	Marine and freshwater portions of the biosphere. Examples include freshwater life zones (such as lakes and streams) and ocean or marine life zones (such as estuaries, coastlines, coral reefs, and the open ocean).
Arid	Dry. A desert or other area with an arid climate has little precipitation.

Artificial selection	Process by which humans select one or more desirable genetic traits in the population of a plant or animal species and then use selective breeding to produce populations containing many individuals with the desired traits. Compare genetic engineering, natural selection
Atmosphere	Whole mass of air surrounding the earth. See stratosphere, troposphere. Compare biosphere, geosphere, hydrosphere.
Autotroph	An organism that can synthesize organic molecules using inorganic molecules and energy from either sunlight (photosynthetic autotrophs) or from inorganic molecules, such as hydrogen sulfide (chemosynthetic autotrophs).

B

Bacteria	Prokaryotic, one-celled organisms. Some transmit diseases. Most act as decomposers and get the nutrients they need by breaking down complex organic compounds in the tissues of living or dead organisms into simpler inorganic nutrient compounds.
Benthic	An adjective referring to the bottom of bodies of waters such as seas, lakes, or streams
Benthos	Bottom-dwelling organisms. Compare decomposer, nekton, plankton.
B horizon	A subsoil in which materials leached from above, generally from the A horizon, accumulate. May be rich in clay, organic matter, iron, and other materials.
Biodiversity	Variety of different species (species diversity), genetic variability among individuals within each species (genetic diversity), variety of ecosystems (ecological diversity), and functions such as energy flow and matter cycling needed for the survival of species and biological communities (functional diversity).
Biogeochemical cycle	Natural processes that recycle nutrients in various chemical forms from the nonliving environment to living organisms and then back to the nonliving environment. Examples include the carbon, oxygen, nitrogen, phosphorus, sulfur, and hydrologic cycles

Biological evolution	Change in the genetic makeup of a population of a species in successive generations. If continued long enough, it can lead to the formation of a new species. Note that populations, not individuals, evolve. See also adaptation, differential reproduction, natural selection, theory of evolution
Biomass	Organic matter produced by plants and other photosynthetic producers; total dry weight of all living organisms that can be supported at each trophic level in a food chain or web; dry weight of all organic matter in plants and animals in an ecosystem; plant materials and animal wastes used as fuel.
Biome	Terrestrial regions inhabited by certain types of life, especially vegetation. Examples include various types of deserts, grasslands, and forests
Biosphere	Zone of the earth where life is found. It consists of parts of the atmosphere (the troposphere), hydrosphere (mostly surface water and groundwater), and lithosphere (mostly soil and surface rocks and sediments on the bottoms of oceans and other bodies of water) where life is found. Compare atmosphere, geosphere, hydrosphere.
Biotic	Living organisms. Compare abiotic
Birthrate	The number of new individuals produced in a population generally expressed as births per individual or per thousand individuals in the population.
Boreal forest	Northern forests that occupy the area south of arctic tundra. Though dominated by coniferous trees they also contain aspen and birch. Also called taiga.

C

Carbon cycle	Cyclic movement of carbon in different chemical forms from the environment to organisms and then back to the environment.
Carnivore	Animal that feeds on other animals. Compare herbivore, omnivore.
Cell	Smallest living unit of an organism. Each cell is encased in an outer membrane or wall and contains genetic material (DNA) and other parts to

	perform its life function. Organisms such as bacteria consist of only one cell, but most organisms contain many cells.
C horizon	A soil layer composed of largely unaltered parent material, little affected by biological activity.
Chlorofl uorocarbons (CFCS)	Organic compounds made up of atoms of carbon, chlorine, and fluorine. An example is Freon-12 (ccl2f2), which is used as a refrigerant in refrigerators and air conditioners and in making plastics such as Styrofoam. Gaseous cfcs can deplete the ozone layer when they slowly rise into the stratosphere and their chlorine atoms react with ozone molecules. Their use is being phased out.
Climate	Physical properties of the troposphere of an area based on analysis of its weather records over a long period (at least 30 years). The two main factors determining an area's climate are its average temperature, with its seasonal variations, and the average amount and distribution of precipitation. Compare weather
Coevolution	Evolution in which two or more species interact and exert selective pressures on each other that can lead each species to undergo adaptations. See evolution, natural selection.
Commensalism	An interaction between organisms of different species in which one type of organism benefits and the other type is neither helped nor harmed to any great degree. Compare mutualism.
Community	Populations of all species living and interacting in an area at a particular time.
Competition	Two or more individual organisms of a single species (intraspecific competition) or two or more individuals of different species (interspecific competition) attempting to use the same scarce resources in the same ecosystem.
Compound	Combination of atoms, or oppositely charged ions, of two or more elements held together by attractive forces called chemical bonds. Examples are NACl, CO2, and C6H12O6. Compare element.
Consumer	Organism that cannot synthesize the organic nutrients it needs and gets its organic nutrients by feeding on the tissues of producers or of other consumers; generally divided into primary

	consumers (herbivores), secondary consumers (carnivores), tertiary (higher-level) consumers, omnivores, and detritivores (decomposers and detritus feeders). In economics, one who uses economic goods. Compare producer
Core	Inner zone of the earth. It consists of a solid inner core and a liquid outer core. Compare crust, mantle.
Crust	Solid outer zone of the earth. It consists of oceanic crust and continental crust. Compare core, mantle.
Currents	Mass movements of surface water produced by prevailing winds blowing over the oceans.

D

Decomposer	Organism that digests parts of dead organisms and cast-off fragments and wastes of living organisms by breaking down the complex organic molecules in those materials into simpler inorganic compounds and then absorbing the soluble nutrients. Producers return most of these chemicals to the soil and water for reuse. Decomposers consist of various bacteria and fungi. Compare consumer, detritivore, producer
Deforestation	Removal of trees from a forested area
Density	1. Mass per unit volume. 2. The number of individuals in a population per unit area
Desert	Biome in which evaporation exceeds precipitation and the average amount of precipitation is less than 25 centimeters (10 inches) per year. Such areas have little vegetation or have widely spaced, mostly low vegetation. Compare forest, grassland.
Desertification	Conversion of rangeland, rain-fed cropland, or irrigated cropland to desert-like land, with a drop in agricultural productivity of 10% or more. It usually is caused by a combination of overgrazing, soil erosion, prolonged drought, and climate change.
Detritivore	Consumer organism that feeds on detritus, parts of dead organisms, and cast-off fragments and wastes of living organisms. Examples include earthworms, termites, and crabs. Compare decomposer.
Detritus	Parts of dead organisms and cast-off fragments

	and wastes of living organisms.
Direct	Interaction negative or positive interaction between two species, including competition, predation, herbivory, and mutualism, that occurs without the involvement of an intermediary species.
Distribution	The geographic range of an organism or the spatial arrangement of individuals in a local population.
Domesticated species	Wild species tamed or genetically altered by crossbreeding for use by humans for food (cattle, sheep, and food crops), pets (dogs and cats), or enjoyment (animals in zoos and plants in botanical gardens). Compare wild species
Dominant species or foundation species	Organisms, such as abundant, forest tree species or reef coral species, that substantially influence community structure as a consequence of their abundance.
Drought	Condition in which an area does not get enough water because of lower-than-normal precipitation or higher-than-normal temperatures that increase evaporation.

E

Ecological diversity	The variety of forests, deserts, grasslands, oceans, streams, lakes, and other biological communities interacting with one another and with their nonliving environment. See biodiversity. Compare functional diversity, genetic diversity, species diversity.
Ecologist	Biological scientist who studies relationships between living organisms and their environment.
Ecology	Biological science that studies the relationships between living organisms and their environment; study of the structure and functions of nature.
Ecosystem	One or more communities of different species interacting with one another and with the chemical and physical factors making up their nonliving environment.
Electromagnetic radiation	Forms of kinetic energy traveling as electromagnetic waves. Examples include radio waves, tv waves, microwaves, infrared radiation, visible light, ultraviolet radiation, x rays, and

	gamma rays.
Endangered species	Wild species with so few individual survivors that the species could soon become extinct in all or most of its natural range. Compare threatened species.
Endemic species	Species that is found in only one area. Such species are especially vulnerable to extinction.
Environment	All external conditions, factors, matter, and energy, living and nonliving, that affect any living organism or other specified system.
Environmental degradation	Depletion or destruction of a potentially renewable resource such as soil, grassland, forest, or wildlife that is used faster than it is naturally replenished. If such use continues, the resource becomes non-renewable (on a human time scale) or nonexistent (extinct). See also sustainable yield.
Environmentalism	Social movement dedicated to protecting the earth’s life support systems for us and other species.
Environmentalist	Person who is concerned about the impacts of human activities on the environment.
Erosion	Process or group of processes by which loose or consolidated earth materials are dissolved, loosened, or worn away and removed from one place and deposited in another. See weathering.
Estuary	The lowermost part of a river, which is under the influence of the tides and is a mixture of seawater and freshwater
Euphotic zone	Upper layer of a body of water through which sunlight can penetrate and support photosynthesis.
Eutrophication	Physical, chemical, and biological changes that take place after a lake, estuary, or slow-flowing stream receives inputs of plant nutrients—mostly nitrates and phosphates—from natural erosion and runoff from the surrounding land basin. See cultural eutrophication.
Evaporation	The process by which a liquid changes from liquid phase to a gas, as in the change from liquid water to water vapor.

F

Food chain	Series of organisms in which each eats or

decomposes the preceding one. Compare food web.

Food web Complex network of many interconnected food chains and feeding relationships. Compare food chain.

Forest Biome with enough average annual precipitation to support the growth of tree species and smaller forms of vegetation. Compare desert, grassland.

Fossil fuel Products of partial or complete decomposition of plants and animals; occurs as crude oil, coal, natural gas, or heavy oils as a result of exposure to heat and pressure in the earth's crust over millions of years. See coal, crude oil, natural gas.

Fossils Skeletons, bones, shells, body parts, leaves, seeds, or impressions of such items that provide recognizable evidence of organisms that lived long ago.

G

Genetic adaptation Changes in the genetic makeup of organisms of a species that allow the species to reproduce and gain a competitive advantage under changed environmental conditions. See differential reproduction, evolution, mutation, natural selection.

Genetic diversity Variability in the genetic makeup among individuals within a single species. See biodiversity. Compare ecological diversity, functional diversity, species diversity

Geosphere Earth's intensely hot core, thick mantle composed mostly of rock, and thin outer crust that contains most of the earth's rock, soil, and sediment. Compare atmosphere, biosphere, hydrosphere

Global climate change Broad term referring to changes in any aspects of the earth's climate, including temperature, precipitation, and storm activity. Compare weather

Global warming Warming of the earth's lower atmosphere (troposphere) because of increases in the concentrations of one or more greenhouse gases. It can result in climate change that can last for decades to thousands of years. See greenhouse effect, greenhouse gases, natural greenhouse effect.

Grassland	Biome found in regions where enough annual average precipitation to support the growth of grass and small plants but not enough to support large stands of trees. Compare desert, forest.
Greenhouse effect	Natural effect that releases heat in the atmosphere (troposphere) near the earth's surface. Water vapor, carbon dioxide, ozone, and other gases in the lower atmosphere (troposphere) absorb some of the infrared radiation (heat) radiated by the earth's surface. Their molecules vibrate and transform the absorbed energy into longer-wavelength infrared radiation (heat) in the troposphere. If the atmospheric concentrations of these greenhouse gases increase and other natural processes do not remove them, the average temperature of the lower atmosphere will increase gradually. Compare global warming. See also natural greenhouse effect.
Greenhouse gases	Gases in the earth's lower atmosphere (troposphere) that cause the greenhouse effect. Examples include carbon dioxide, chlorofluorocarbons, ozone, methane, water vapor, and nitrous oxide.

H

Habitat	Place or type of place where an organism or population of organisms lives. Compare ecological niche.
Heat	Total kinetic energy of all randomly moving atoms, ions, or molecules within a given substance, excluding the overall motion of the whole object. Heat always flows spontaneously from a warmer sample of matter to a colder sample of matter. This is one way to state the second law of thermodynamics. Compare temperature.
Herbivore	Plant-eating organism. Examples include deer, sheep, grasshoppers, and zooplankton. Compare carnivore, omnivore.
Heterotroph	An organism that uses organic molecules both as a source of carbon and as a source of energy.
Homeotherm	An organism that uses metabolic energy to maintain a relatively constant body temperature; such organisms are often called warm-blooded.

Hydrologic cycle Biogeochemical cycle that collects, purifies, and distributes the earth's fixed supply of water from the environment to living organisms and then back to the environment.

Hydrosphere Earth's liquid water (oceans, lakes, other bodies of surface water, and underground water), frozen water (polar ice caps, floating ice caps, and ice in soil, known as permafrost), and water vapor in the atmosphere. See also hydrologic cycle. Compare atmosphere, biosphere, geosphere.

I

Immigration Migration of people into a country or area to take up permanent residence.

Indirect interaction Negative or positive interaction between two species, including trophic cascades, apparent competition, and indirect mutualism or commensalism, that is mediated through a third species.

Inorganic compounds All compounds not classified as organic compounds. See organic compounds.

Interspecific competition Attempts by members of two or more species to use the same limited resources in an ecosystem. See competition, intraspecifi c competition.

Intraspecific competition Attempts by two or more organisms of a single species to use the same limited resources in an ecosystem. See competition, interspecifi c competition.

Invertebrates Animals that have no backbones. Compare vertebrates

K

Keystone species Species that, despite low biomass, exert strong effects on the structure of the communities they inhabit.

L

Landscape A heterogeneous area consisting of distinctive patches, or landscape elements, organized into a mosaic-like pattern.

Law of tolerance Existence, abundance, and distribution of a species in an ecosystem are determined by whether the levels of one or more physical or chemical factors fall within the range tolerated by the species. See threshold effect.

Limiting factor Single factor that limits the growth, abundance, or distribution of the population of a species in an ecosystem. See limiting factor principle

Limiting factor principle Too much or too little of any abiotic factor can limit or prevent growth of a population of a species in an ecosystem, even if all other factors are at or near the optimal range of tolerance for the species.

Littoral zone The shallowest waters along a lake or ocean shore; where rooted aquatic plants may grow in lakes

M

Matter Anything that has mass (the amount of material in an object) and takes up space. On the earth, where gravity is present, we weigh an object to determine its mass.

Microorganisms Organisms such as bacteria that are so small that it takes a microscope to see them

Migration Movement of people into and out of specific geographic areas. Compare emigration and immigration.

Mineral resource Concentration of naturally occurring solid, liquid, or gaseous material in or on the earth's crust in a form and amount such that extracting and converting it into useful materials or items is currently or potentially profitable. Mineral resources are classified as metallic (such as iron and tin ores) or nonmetallic (such as fossil fuels, sand, and salt).

Mineralization The breakdown of organic matter from organic to inorganic form during decomposition.

Mutualism Type of species interaction in which both participating species generally benefi t. Compare commensalism.

N

Natural selection Process by which a particular beneficial gene (or

	set of genes) is reproduced in succeeding generations more than other genes. The result of natural selection is a population that contains a greater proportion of organisms better adapted to certain environmental conditions. See adaptation, biological evolution, differential reproduction, mutation.
Nekton	Strongly swimming organisms found in aquatic systems. Compare benthos, plankton.
Niche	The environmental factors that influence the growth, survival, and reproduction of a species.
Nitrogen cycle	Cyclic movement of nitrogen in different chemical forms from the environment to organisms and then back to the environment
Nitrogen fixation	Conversion of atmospheric nitrogen gas into forms useful to plants by lightning, bacteria, and cyanobacteria; it is part of the nitrogen cycle.
	Nonrenewable resource Resource that exists in a fixed amount (stock) in the earth's crust and has the potential for renewal by geological, physical, and chemical processes taking place over hundreds of millions to billions of years. Examples include copper, aluminum, coal, and oil. We classify these resources as exhaustible because we are extracting and using them at a much faster rate than they are formed. Compare renewable resource
Nutrient	Any chemical element or compound an organism must take in to live, grow, or reproduce

O

Oceanic zone	The open ocean beyond the continental shelf with water depths generally greater than 200 m.
O (organic) horizon	The most superficial soil layer containing substantial amounts of organic matter, including whole leaves, twigs, other plant parts, and highly fragmented organic matter.
Omnivore	Animal that can use both plants and other animals as food sources. Examples include pigs, rats, cockroaches, and humans. Compare carnivore, herbivore.
Organic compounds	Compounds containing carbon atoms combined with each other and with atoms of one or more

other elements such as hydrogen, oxygen, nitrogen, sulfur, phosphorus, chlorine, and fluorine. All other compounds are called inorganic compounds.

Overfishing Harvesting so many fi sh of a species, especially immature individuals, that not enough breeding stock is left to replenish the species and it becomes unprofi table to harvest them.

Overgrazing Destruction of vegetation when too many grazing animals feed too long and exceed the carrying capacity of a rangeland or pasture area.

Ozone (O3) Colorless and highly reactive gas and a major component of photochemical smog. Also found in the ozone layer in the stratosphere. See photochemical smog.

Ozone layer Layer of gaseous ozone (O3) in the stratosphere that protects life on earth by filtering out most harmful ultraviolet radiation from the sun.

P

Parasite Consumer organism that lives on or in, and feeds on, a living plant or animal, known as the host, over an extended period. The parasite draws nourishment from and gradually weakens its host; it may or may not kill the host. See parasitism.

Parasitism Interaction between species in which one organism, called the parasite, preys on another organism, called the host, by living on or in the host. See host, parasite.

Photosynthesis Complex process that takes place in cells of green plants. Radiant energy from the sun is used to combine carbon dioxide (CO2) and water (H2O) to produce oxygen (O2), carbohydrates (such as glucose, C6H12O6), and other nutrient molecules. Compare aerobic respiration, chemosynthesis.

Phytoplankton Small, drifting plants, mostly algae and bacteria, found in aquatic ecosystems. Compare plankton, zooplankton.

Plankton Small plant organisms (phytoplankton) and animal organisms (zooplankton) that float in aquatic ecosystems.

Pollutant Particular chemical or form of energy that can adversely affect the health, survival, or activities of

	humans or other living organisms. See pollution
Pollution	Undesirable change in the physical, chemical, or biological characteristics of air, water, soil, or food that can adversely affect the health, survival, or activities of humans or other living organisms.
Population	Group of individual organisms of the same species living in a particular area.
Population change	Increase or decrease in the size of a population. It is equal to (Births + Immigration) (Deaths + Emigration).
Population distribution	Variation of population density over a particular geographic area or volume. For example, a country has a high population density in its urban areas and a much lower population density in rural areas
Population dynamics	Major abiotic and biotic factors that tend to increase or decrease the population size and affect the age and sex composition of a species.
Population size	Number of individuals making up a population's gene pool.
Predation	Interaction in which an organism of one species (the predator) captures and feeds on parts or all of an organism of another species (the prey).
Predator	Organism that captures and feeds on parts or all of an organism of another species (the prey).
Prey	Organism that is captured and serves as a source of food for an organism of another species (the predator).
Primary consumer	Organism that feeds on all or part of plants (herbivore) or on other producers. Compare detritivore, omnivore, secondary consumer.
Primary succession	Ecological succession in a bare area that has never been occupied by a community of organisms. See ecological succession. Compare secondary succession.
Producer	Organism that uses solar energy (green plants) or chemical energy (some bacteria) to manufacture the organic compounds it needs as nutrients from simple inorganic compounds obtained from its environment. Compare consumer, decomposer.
Pyramid of energy flow	Diagram representing the flow of energy through each trophic level in a food chain or food web. With each energy transfer, only a small part (typically 10%) of the usable energy entering one

trophic level is transferred to the organisms at the next trophic level.

R

Radioactivity	Nuclear change in which unstable nuclei of atoms spontaneously shoot out “chunks” of mass, energy, or both at a fixed rate. The three principal types of radioactivity are gamma rays and fast-moving alpha particles and beta particles.
Random distribution	a distribution in which individuals within a population have an equal chance of living anywhere within an area.
Range of tolerance	Range of chemical and physical conditions that must be maintained for populations of a particular species to stay alive and grow, develop, and function normally. See law of tolerance.
Rare species	Species that has naturally small numbers of individuals (often because of limited geographic ranges or low population densities) or that has been locally depleted by human activities.
Recycling	Collecting and reprocessing a resource so that it can be made into new products. An example is collecting aluminum cans, melting them down, and using the aluminum to make new cans or other aluminum products. Compare reuse.
Renewable resource	Resource that can be replenished rapidly (hours to several decades) through natural processes as long as it is not used up faster than it is replaced. Examples include trees in forests, grasses in grasslands, wild animals, fresh surface water in lakes and streams, most groundwater, fresh air, and fertile soil. If such a resource is used faster than it is replenished, it can be depleted and converted into a nonrenewable resource. Compare nonrenewable resource and perpetual resource. See also environmental degradation.
Reproduction	Production of offspring by one or more parents.

S

Salinity	The salt content of water.
Secondary consumer	Organism that feeds only on primary consumers. Compare detritivore, omnivore, primary consumer.

Secondary succession	Succession where disturbance has destroyed a community without destroying the soil; for instance, forest succession following a forest fire or logging.
Soil	Complex mixture of inorganic minerals (clay, silt, pebbles, and sand), decaying organic matter, water, air, and living organisms.
Solar energy	Direct radiant energy from the sun and a number of indirect forms of energy produced by the direct input of such radiant energy. Principal indirect forms of solar energy include wind, falling and fl owing water (hydropower), and biomass (solar energy converted into chemical energy stored in the chemical bonds of organic compounds in trees and other plants)—none of which would exist without direct solar energy.
Species	Group of similar organisms, and for sexually reproducing organisms, they are a set of individuals that can mate and produce fertile offspring. Every organism is a member of a certain species.
Succulent plants	Plants, such as desert cacti, that survive in dry climates by having no leaves, thus reducing the loss of scarce water. They store water and use sunlight to produce the food they need in the thick, fleshy tissue of their green stems and branches. Compare deciduous plants, evergreen plants.

T

Taiga	Northern forests that occupy the area south of arctic tundra. Though dominated by coniferous trees they also contain aspen and birch. Also called boreal forest.
Thermophilic	A term applied to organisms that tolerate or require high-temperature environments.
Transpiration	Process in which water is absorbed by the root systems of plants, moves up through the plants, passes through pores (stomata) in their leaves or other parts, and evaporates into the atmosphere as water vapor
Trophic level	All organisms that are the same number of energy transfers away from the original source of energy (for example, sunlight) that enters an ecosystem.

For example, all producers belong to the first trophic level, and all herbivores belong to the second trophic level in a food chain or a food web.

Troposphere Innermost layer of the atmosphere. It contains about 75% of the mass of earth's air and extends about 17 kilometers (11 miles) above sea level. Compare stratosphere.

Tundra A northern biome dominated by mosses, lichens, and dwarf willows, receiving low to moderate precipitation and having a very short growing season.

U

Urban ecology The study of urban areas as complex, dynamic ecological systems, influenced by interconnected, biological, physical, and social components.

W

Weather Short-term changes in the temperature, barometric pressure, humidity, precipitation, sunshine, cloud cover, wind direction and speed, and other conditions in the troposphere at a given place and time. Compare climate.

Wetland Land that is covered all or part of the time with salt water or fresh water, excluding streams, lakes, and the open ocean. See coastal wetland, inland wetland.

Wildlife All free, undomesticated species. Sometimes the term is used to describe animals only.

Worldview How people think the world works and what they think their role in the world should be. See environmental wisdom worldview, planetary management worldview, stewardship worldview.

Z

Zooplankton Animal plankton; small floating herbivores that feed on plant plankton (phytoplankton). Compare phytoplankton.

VOCABULARY

A

Abiotic	1) абиотический; 2) неживой; нежизненный
Absorb	всасывать, впитывать; абсорбировать; поглощать
Abundance	1) обилие, изобилие, большое количество; 2) численность, относительное содержание (число особей на единицу пространства)
Accessible	доступный (to); достижимый
Acid	кислота
Acid rain	кислотный дождь
Activity	деятельность
Adaptation	адаптация
Admission	госпитализация, приём больного в стационар
Affected	поражённый, травмированный
Air	воздух
Air current	воздушная струя; воздушный поток
Alternate	сменять, сменять друг друга (with); чередовать (ся), колебаться (between); делать попеременно
Alternative types/sources of energy	альтернативные источники энергии
Altitude	высота; высота над уровнем моря
Apparent	видимый, видный
Apply	применять, использовать, употреблять (to)
Assessment	определение, установление (например, сроков беременности); оценка (жизнеспособности)
Assume	1) принимать, брать на себя (ответственность, управление и т.п.); 2) принимать (характер, форму); 3) прикидываться, симулировать, притворяться); 4) присваивать, предъявлять претензию, заявлять права на что-либо
Atmosphere	атмосфера
Average temperature	средняя температура

B

Be threatened with extinction	быть под угрозой вымирания
Benthic (benthonic)	бентический, бентосный, обитающий на дне
Biodiversity	биоразнообразие

Bioresorbable	биологический саморазрушающийся
Biosphere	биосфера
Blizzard	вьюга
Blood clotting	свёртывание крови
Blossom	цвести; распускаться; расцветать
Bog	болото
Boreal forest	тайга, бореальный лес
Breakthrough	1) прорыв; breakthrough charge – атака с целью прорыва; 2) достижение, открытие, победа (научная и т.п.)
Breeding	разведение, размножение (животных, растений)

C

Cadaver	труп
Cancer	рак (заболевание)
Canopy	1) покров; 2) листовой [древесный] полог
Capacity	способность
Carbon dioxide	углекислота, углекислый газ
Carnivorous	плотоядный
Cell	клетка
Cellular respiration	клеточное дыхание
Coal	уголь
Compatibility	совместимость, совместность, сочетаемость
Compose	составлять
Consequences	последствия
Consume	потреблять, расходовать, поглощать, тратить
Contaminate	заражать, инфицировать
Create	порождать, производить, создавать, творить
Cripple	1) а) получать травму (конечности), травмировать (конечность) (особ. ногу); б) калечить, лишать трудоспособности; 2) хромать, ковылять 3) портить, приводить в негодность; наносить ущерб
Current	текущий, данный, современный

D

Damage	урон, ущерб
Define	определять
Density	густота, плотность, сосредоточенность (определенного количества каких-либо единиц в определенном районе); концентрация

Desertification	опустынивание
Destroy	разрушать, рушить, сносить; ликвидировать; стирать с лица земли
Disastrous	бедственный, гибельный, пагубный (to)
Discrete	отдельный; обособленный; изолированный; отличный
Disorder	нарушение, расстройство (какой-л. функции организма)
Dissolve	разлагать(ся); 2) растворять(ся)
Dissolved compound	растворённое соединение
Distinct	отдельный; особый, индивидуальный; отличный (от других – from)
Distribution	распределение, распространение
Drought	засуха

E

Earth	Земля
Ecology	Экология
Ecosystem	экосистема
Emergency	чрезвычайное происшествие
Endangered species	исчезающий вид
Enhancement	повышение, прирост, увеличение
Environment	окружающая среда
Equilibrium	баланс, равновесие, устойчивость; равновесность
Evaporation	испарение
Evergreen	1) вечнозеленый; 2) вечнозеленое растение
Exploitation	использование, употребление, эксплуатация
Extend	1) простираться; 2) распространяться
Extinction	1) угасание; 2) вымирание; исчезновение
Extraneous	внешний, поступающий извне; посторонний, чуждый (to)

F

Factor	Фактор
Factory	Завод
Farming	Земледелие
Facilities	средства
Feature	Особенность, черта
Fire-fighter truck, fire engine	Пожарная машина
Fireproof	Огнестойкий

Fertility	Плодородие; изобилие (в области животного и растительного мира)
First aid	Первая помощь
Flooding	Паводок
Flook	Стая
Forest	Лес
Fossil fuel	Ископаемое топливо
Fracture	Перелом; разрыв мягких тканей
Freshwater	пресноводный
Fuel	Топливо
Fungi	грибы

G

Garbage	Бытовые отходы
Gas	Газ
Genus	1) род; 2) сорт; вид, род
Geography	География
Global	Глобальный
Globe	Вселенная
Grass	трава
Greenhouse effect	парниковый эффект
Greenhouse gas	Парниковый газ

H

Habitat	Среда обитания, место распространения, ареал (животного, растения); естественная среда
Harm	Причинять вред
Harsh continental climate	Резко континентальный климат
Hazard	Опасность
Heat	Тепло, жара
Humid	влажный, мокрый, сырой, отсыревший
Humidity	Влажность
Hurricane	Ураган
Hydrocarbons	Углеводороды
Hydrogen-sulphide	Сероводород

I

Icecap	ледниковый покров (в горах); полярный лед
Impact environmental	Воздействие на окружающую среду

Industrial disease	Профессиональное заболевание
Industrial revolution	Промышленная революция
Inhabit	жить, населять, обитать, проживать, существовать
Influence	влияние, действие, воздействие

J

Jelly-fish	медуза
Jet airplane fuel	Топливо для реактивных двигателей
Joint Nature Conservation Committee	Объединенный комитет охраны природы
Joule	Джоуль (Дж)
Jungle	Джунгли
Juvenile	Ювенильный (несовершеннолетний)

K

Keystone species	Ключевые виды
Kilogram	Килограмм
Kilometre	Километр
Kingdom	Царство
Krotovina	Кротовина
Kyoto Protocol	Киотский протокол

L

Lahar	Сель
Landscape	Ландшафт
Latitude	широта
Layer	Ярус
Lentic	стоячий (о воде)
Limit: maximum concentration limit (MCL)	Предельно допустимая концентрация (ПДК)
List of endangered species	красная книга
Littoral	прибрежный; приморский
Living matter	живая материя
Logging	заготовка и транспортировка леса; количество срубленного леса
Lotic	проточный (о воде)

M

Mammal	Млекопитающее
Marsh	Болото, топь
Meadow	Луг, луговина; низина, пойменная земля
Moist	Сырой; влажный, мокрый
Motor accident	Автомобильная катастрофа
Multicellular	Многоклеточный

N

Natural calamity	Стихийное бедствие
Niche	Ниша (экологическая)
Non-renewable resources	Невозобновляемые ресурсы
Noosphere	Ноосфера
Nuclear	Ядерный
Nuclear waste	Радиоактивные отходы
Nucleic acid	Нуклеиновая кислота
Nutrient	Питательное вещество

O

Objective	Задача; стремление
Observe	Наблюдать, замечать, обращать внимание
Observation	Наблюдение
Occupational risk	Производственный риск
Oil (petroleum)	Нефть
Ointment	Мазь, притирание
Omnivor (omnivore)	Всеядное животное
Ooze	Ил, болото
Outer layer –	наружный слой
Overdevelopment	Чрезмерная эксплуатация территории
Oxidation	Окисление, озоление
Ozone hole	озоновая дыра
Ozone layer	Озоновый слой

P

Parcel	1) часть (только в сочетаниях) – part and parcel, instalment; 2) участок земли
Pathway	1) тропа; тропинка; дорожка; дорога, путь; 2) направление, траектория

Pedology	почвоведение
Pedogenesis	Почвообразование
Pelagic	пелагический, морской, океанический
Permanent inhabitant	постоянный житель, обитатель (о людях и животных)
Pest	Вредитель
Phenomenon	явление
Phosphorus	фосфор
Photic zone	световая зона (толщи воды)
Plague	1) эпидемическое заболевание с большой смертностью; 2) чума; 3) вспышка массового размножения вредных животных
Poisonous	Ядовитый
pollination	опыление
Pollutant	Загрязнитель
Polluter	Источник загрязнения
Pollution	Загрязнение
Pond	пруд; маленькое озеро
Precipitation	1) осаждение, преципитация; 2) осадки; атмосферные осадки; 3) выпадение осадков
Predation (predatism)	хищничество
Preserve	Заповедник, заказник
Prey	1) ловить, охотиться; 2) добыча, жертва
Primary production	1) первичная продукция; 2) первое звено в пищевой цепи; 3) производство сырых материалов
Protection	Защита (охрана)
Purification	Очистка
Purifier	Очиститель

R

Radiant	Излучающий
Rainfall	1) количество осадков; 2) ливень
Rainforest	тропический лес; влажные джунгли
Raptor	хищник
Recovery	восстановление, выздоровление, излечение (благоприятный результат лечения), исцеление, пробуждение (после наркоза)
Recycling	1. Рециркуляция 2. Повтор
Relationship	Взаимосвязь, отношения
Release	выброс; высвобождение;
Renewable energy	возобновляемая энергия
Riparian	прибрежный, находящийся на берегу,

	относящийся к берегу
Rock-fall	Обвал
Rubbish	Мусор

S

Safety	Безопасность
Saturated soil	водонасыщенный грунт
Salinity	соленость
Secondary energy source	вторичный источник энергии
Shallow depths	небольшая глубина
Share	делить, распределять; разделять
Sleet	Гололед
Slide	Оползень, лавина
Smog	Смог
Smoke	Дым
Soil	грунт, земля, почва
Solar insolation	освещение (предмета) лучами солнца
Solar energy	солнечная энергия, энергия Солнца
Species	Вид
Spruce	1) ель; 2) хвойное дерево
Steppe	степь
Stream	поток, река, ручей; струя, течение
Subdue	подчинять, покорять
Survival	выживание, переживание
Sustainable	устойчивый; экологически рациональный; способный существовать, не нанося ущерба окружающей среде

T

Terrestrial life	Земной, наземный, континентальный; флора и фауна суши
Transduction	преобразование
Treatment	Очистка, обработка

U

Underwood	подлесок, подлесье
Underlying	1) лежащий или расположенный под чем-либо 2) основной; лежащий в основе
Unicellular	Одноклеточный
Unit	Единица

V

Vaporability	Испаряемость
Variety	многообразие, разнообразие
Vertebra	позвоночник
Viability	жизнеспособность; жизненность, жизнестойкость

W

Waterlogging	Подтопление
Wildlife	Дикая природа
Woodland	лесистая местность
World Health Organization (WHO)	Всемирная Организация Здравоохранения (ВОЗ)
Worry about	беспокоиться о чем-л. или о ком-л.

X

X-rays	Рентгеновские лучи

Y

Yield	Урожай, объем заготовок

Z

Zone	Зона

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