

Topic # 5

Adaptation of organisms to the environment and living conditions

Motivation

Representatives of the animal and plant world in the process of life are forced to adapt to many factors of continuously changing conditions. The dynamism of environmental factors in time and space depends on astronomical, helioclimatic, geological processes, which play a controlling role in relation to living organisms.

Traits that promote the survival of an organism are gradually enhanced under the influence of natural selection until maximum adaptability to existing conditions is achieved. Adaptation can occur at the level of cells, tissues and even the whole organism, affecting the shape, size, relationship of organs, etc. Organisms, in the process of evolution and natural selection, develop hereditarily fixed characteristics that ensure normal life in changed environmental conditions, i.e. adaptation. Knowledge of the patterns of adaptations is necessary to explain the mechanism of their occurrence and can be used in the practical work of pharmaceutical specialists.

Purpose of the lesson: to introduce the variety of anatomical, morphological, physiological and ethological manifestations of adaptation of organisms to the environment; general principles of adaptation at the level of the organism, to develop the ability to use knowledge of the laws of adaptation to explain the mechanism of their occurrence

Questions for oral questioning:

1. Environmental factors. Types of environmental factors, examples of ecological factors and adaptations (genotypic and phenotypic levels of adaptation).
2. Patterns of the impact of environmental factors on the body: the rule of optimum in ecology; Liebig's minimum rule ecology; Shelford's rule of tolerance; rule of two levels of adaptation;
2. Patterns of the impact of environmental factors on the body: the ambiguity of the factor's effect on various functions of the body; the rule of interaction of factors; law of ecological duplication.
3. Adaptation of the body to environmental factors. Basic laws and rules of adaptation (Anatomical, physiological and behavioral adaptations).
4. Basic mechanisms for the formation of adaptations at the organism level.

List of knowledge and practical skills

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

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

Independent work of students in class

1. Presentation with abstract reports on the topic of the lesson (individual assignment).
2. Solving situational problems on the topic of the seminar.
3. Participation in a regulated discussion (the topic is indicated in the assignment for the practical lesson).

Topics of regulated discussion:

1. The need to know the laws of adaptation for students of the Faculty of Pharmacy.
4. Working with training tests

Test

After familiarizing yourself with the theoretical principles of the formation of adaptation mechanisms, complete the task (choose the correct judgments from the options below)

1. 1.Environmental factors can have both direct and indirect effects on organisms.
- 1.2. An individual's tolerance remains unchanged throughout life.
- 1.3. Any environmental factor has certain limits of positive influence on living organisms.
- 1.4. High specialization is characteristic only of organisms with a short life expectancy.
- 1.5. During evolution, similar life forms can arise in similar ecological conditions in systematically different groups of organisms.
- 1.6. The ecological niches of co-living species may partially overlap, and sometimes coincide completely.
- 1.7. A species is characterized by only one specific niche, regardless of its habitat and geographic area.
- 1.8. Organisms that are systematically distant from each other can occupy similar niches in ecosystems.
- 1.9. Organisms with a wide range of tolerance tend to have a better chance in the struggle for existence.
- 1.10. Any factor influencing living organisms can become either optimal or limiting, depending on the strength of its impact.
2. 1. Adaptive biological rhythms differ from purely physiological rhythms in that they arose as adaptations:
 - a) to maintain the continuous life of organisms;
 - b) to regular environmental changes in the environment;
 - c) to episodic effects of biotic environmental factors;

d) to regulate the birth rate and mortality of organisms.

Reference material

Environmental factors are diverse, have different natures and specific actions. The following groups of environmental factors are distinguished:

1. *Abiotic* (factors of inanimate nature):

- a) climatic - lighting conditions, temperature conditions, etc.;
- b) edaphic (local) - water supply, soil type, terrain;
- c) orographic - air (wind) and water currents.

2. *Biotic* factors are all forms of influence of living organisms on each other:

Plants Plants . Plants Animals. Plants Mushrooms. Plants Microorganisms. Animals
Animals . Animals Mushrooms. Animals Microorganisms. Mushrooms Mushrooms
. Fungi Microorganisms. Microorganisms Microorganisms .

3. *Anthropogenic* factors are all forms of activity of human society that lead to changes in the habitat of other species or directly affect their lives. The impact of this group of environmental factors is rapidly increasing from year to year.

Types of impact of environmental factors on organisms. Environmental factors have various impacts on living organisms. They may be:

- irritants that contribute to the appearance of adaptive physiological and biochemical changes (hibernation, photoperiodism);
- limiters that change the geographical distribution of organisms due to the impossibility of existence in these conditions;
- modifiers that cause morphological and anatomical changes in organisms;
- signals indicating changes in other environmental factors.

Adaptations (from Latin adaptatio - adaptation) *are* various adaptations to the environment developed in organisms during the process of evolution. Adaptations manifest themselves at different levels of organization of living matter: from molecular to biocenotic. The ability to adapt is one of the main properties of living matter, ensuring the possibility of its existence. Adaptations develop under the

influence of three main factors: heredity, variability and natural (as well as artificial) selection.

Adaptation is a fundamental property of living nature. The habitat of any living creature, on the one hand, slowly and steadily changes over the life of many generations of the corresponding biological species, and on the other hand, it makes various demands on the body that change in short periods of individual life. Living organisms are discrete units of metabolism. In the process of metabolism, the body consumes necessary substances from the environment and releases into it metabolic products that can be used by other organisms; By dying, the organism also becomes a source of nutrition for certain types of living beings. Metabolic processes in a living organism occur in a dynamic environment and are under the constant influence of a complex of factors. Maintaining a stable metabolism in changing environmental conditions is impossible without the formation of special adaptations.

There are three main ways for organisms to adapt to environmental conditions: the active path, the passive path, and the avoidance of adverse effects. *The active **path*** is strengthening resistance, developing regulatory processes that allow all vital functions of the body to be carried out, despite factor deviations from the optimum. For example, maintaining a constant body temperature in warm-blooded animals (birds and mammals), optimal for the occurrence of biochemical processes in cells.

Passive way - subordination of the vital functions of the body to changes in environmental factors. For example, the transition under unfavorable environmental conditions to a state of *anabiosis* (hidden life), when the metabolism in the body almost completely stops (winter dormancy of plants, preservation of seeds and spores in the soil, torpor of insects, hibernation of vertebrates, etc.).

Avoidance of Adverse Effects — development by the body of such life cycles and behavior that allow it to avoid adverse effects. For example, seasonal migrations of animals.

Typically, adaptation of a species to its environment is carried out by one or another combination of all three possible adaptation paths.

Adaptations can be divided into three types: morphological, physiological and ethological.

Morphological adaptations are accompanied by changes in the structure of the organism (for example, modification of the leaf in desert plants). Morphological adaptations in plants and animals lead to the formation of certain life forms.

Physiological adaptations - changes in the physiology of organisms (for example, the ability of a camel to provide the body with moisture by oxidizing fat reserves).

Ethological adaptations - changes in behavior (for example, seasonal migrations of mammals and birds, hibernation in winter). Ethological adaptations are characteristic of animals.