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Lecture 1

Biology as a complex of Sciences about living nature. The importance of biology in the training of a doctor. The cell is an elementary biological system

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PLAN

1. The definition of life. Fundamental properties of living systems. Biopoiesis.

2. Biology as the science of life, its place in the system of medical Sciences.

3. Man is the Central object of modern biology

4 Levels of organization of living things.

5. Cell theory. Types of cellular organization

6. Structural and functional organization of eukaryotic cells

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Biology is the science of life.

What is life? This philosophical question has interested people since ancient times.

The ancient Greek scientist Aristotle proposed one of the first definitions of the concept of «life». He said that LIFE is nourishment, growth, senility. LIFE is purposefulness.

According to A. Lavoisier, LIFE is a chemical function.

I. Р. Pavlov also considers LIFE as a complex chemical process.

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F. ENGELS argues that LIFE is a way of existence of protein bodies. The constant exchange of substances with the surrounding external nature is an essential point for it. Moreover, with the cessation of this metabolism ceases and the life. This causes the protein to decompose.

M. V. Volkenstein considers Living bodies as open self-regulating and self-reproducing systems constructed from biopolymers-proteins and nucleic acids.

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These two statements form the basis of the modern definition of LIFE

LIFE is a colloidal, macromolecular open system, which is characterized by hierarchical organization, the ability to self-build, self-renewal, self-reproduction and self-regulation with constant exchange of matter, energy and information with the environment.

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All living objects have a number of similar characteristics:

Properties of living systems

Unity of chemical composition (all living objects consist of identical chemical elements)

Discreteness and integrity (all living objects are individual, but consist of structural parts)

Exchange of substances, energy and information (living systems are always open to the receipt and release of substances and energy in the course of their life)

Order in space and time (all parts of life are interconnected and interdependent)

Self-reproduction and self-renewal (biological objects are capable of reproduction and long-term maintenance of homeostasis= constancy)

Heredity and variability (reflects the ability of living organisms to transmit their characteristics to offspring and the possibility of their change)

Growth and development (is the result of interaction with the environment based on individual characteristics)

Irritability and movement (the ability to perceive external changes in the environment and form changes in the activity of a living object in accordance with them).

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Origin of life

Theories of the origin of life will be discussed later when we consider evolutionary processes. Now we will only indicate the main points of life formation in accordance with the most widely accepted theory of biopoiesis, proposed by D. Bernal (1947). Biopoiesis-the origin of life, or abiogenesis — the process of transformation of inanimate nature into a living one. This theory is based on the biochemical hypothesis of the origin of life - the Oparin – Haldane theory (1924-1928).

Stages:

1 Abiogenic-synthesis of organic compounds from inorganic

2 Synthesis of monomers: methane, ammonia, hydrogen sulfide, carbon monoxide and dioxide, cyanide compounds

3 Polymerization of monomers into biological polymers-polypeptides and polynucleotides

4 Formation of biopolymers by self-doubling; Doubling becomes complementary – there is a transition of one structure to another: DNA-RNA-Protein

5 The formation of biomembranes

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The number of membranes in a cell is a phylogenetic feature. The more membranes there are, the higher the level of cell organization.

The emergence of membranes led to the largest aromorphosis – the emergence of a new group of living organisms-eukaryotes.

Scheme of symbiotic origin of eukaryotes

 Emergence of eukaryotes with mitochondria, cell membrane and flagellum.

 Biology as the science of life, its place in the system of medical Sciences.

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The term "biology" was proposed by the French scientist J. B. Lamarck in 1802.

The term "BIOLOGY" – (Greek bios – life, logos-word, concept , science) was introduced independently in 1802 by J. B. Lamarck and G. Treviranus

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Biology is the science of life.

Modern biology is a complex science. It formed as a result of differentiation and integration of different scientific fields.

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 The subject of biology is: structure, physiology, behavior, ontogenesis, phylogeny, development of organisms and their relationship with each other and their environment.

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 Main tasks of biological science:

1. Finding out the essence of life and developing methods for managing life processes.

2. Study of molecular and genetic mechanisms. Possibility of their use in medicine.

3. Protection of the biosphere and development of environmental measures.

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BIOLOGY is divided into a whole range of disciplines

Biological Sciences

Zoology botany human anatomy and physiology

protozoology Mycology hygiene

acarologia briology morphology

entomology, Algology, anthropology

lichenology

virology

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Morphological disciplines

Cytology histology anatomy

Integrative Sciences

Biophysics Genetics Biochemistry Radiobiology

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Man is the Central object of modern biology

Biological knowledge not only allows you to create a scientific picture of the world, but can also be used for practical purposes.

The practical application of biology is unlimited. Currently, biological knowledge is used in all spheres of human activity: in industry and agriculture, medicine and energy.

As a result of biological research, great progress has been made, especially in medicine.

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Biology is a very important subject in the work of a doctor. Humans, as a species, are multicellular eukaryotic organisms. It belongs to the chordal type, a class of mammalian animals. The biological laws of functioning work for man, as for any living organism. We will be studied these laws in biology classes.

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The main object of the doctor's activity is a Person who represents a part of the living nature

MAN is a biosocial being.

it has a biological essence:

- large volume of the cerebral cortex,

- binocular vision,

- released forelimbs,

- changing the gene pool under the influence of natural selection factors

and it has a social essence:

social structure, labor, production that ensure the survival, distribution and well-being of a person.

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The accumulation of knowledge on human anatomy is closely related to the history of its development.

"Every doctor needs to understand the nature of" Hippocrates

"Medicine taken in terms of theory - first of all, General biology" Davydovsky I. V.

Knowledge of Aztec anatomy is related to the ritual of human sacrifice.

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Human anatomy was interested in the famous medieval Persian scientist, philosopher and physician Avicenna (Ibn-Sina), the image of the works

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Page from the Indian herbalist Illustration from the herbalist Dioscorides, reprinted in the XIII century.

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Researchers described their observations and passed on their knowledge to new generations of doctors.

Until the XVII century, Avicenna's work "Canon of medical science" was the best medical work for doctors of the East and West.

In the development of biology and medicine huge contribution made by such scientists as:

Linnaeus T. Schwann Mendel T. Morgan H Darwin I. Schmalhausen

According to the observations of I. V. Davydovsky, " the Regularity of diseases follows from the basic properties of life – from the ability to adapt to changing environmental conditions. The fullness of adaptation is the fullness of health!".

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Levels of organization

Living objects are always complex, multi-component systems. Therefore, we can consider their features at different levels of their organization.

Levels of the organization reflect:

- the most important biological phenomena;

- features of the existence of life;

- General structure of the evolutionary process

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An elementary unit (EU) is a structure or object

An elementary phenomenon (EP) is a natural change in the EU during the preservation and development of life

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Life can be divided into many levels. Living **o**rganisms contain many structures and systems that have their own important characteristic, function.

 1 The molecular level of life organization is the first level of studying biology. EU is gene, an elementary phenomenon of EP is convariant replication, or self-replication with the occurrence of certain changes in the matrix Biological polymers, such as DNA, RNA, and proteins, are the basis for the existence and functioning of biological objects at any level.

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2 Cellular level - EU is cell, EP is cell metabolism (flows of matter, energy, information);

All living things are made up of cells. Very simple organisms such as yeast [jiːst] or bacteria consist of only one cell. They are one-celled or unicellular organisms.

Despite its small size, each cell is a tiny drop of life.

Some cells can exist independently, lake bacteria.

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3 Tissue-organ level - Eu is a set of similar cells, EP is the formation of structure and functioning in a single organism

Human cells have lost this independently ability. They depend on each other and special**iz**e in a particular [pəˈtɪkjʊlə] function.

Groups of cells of the same shape, size, and function form a tissue. When tissues of different types are grouped together for a common function, they form an organ.

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4. Organism (ontogenetic) level: EU is individual, EP is patterns of individual changes in ontogenesis (growth, differentiation of parts, integration);

A large **o**rganism, such as a human, contains billions and trillions of cells and is called a multicellular **o**rganism.

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5 Species level: EU is population, EP is -evolutionarily significant changes in the population's gene pool due to elementary evolutionary factors)

Organisms those are similar in structure and physiology form populations and species. They live on the same territory, freely interbreed and produce fert**i**le offspring.

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6. Biogeocenotic level: EU is biogeocenosis EP is material and energy cycle Individual organisms interact with the environment and among themselves such interactions consider the biogeocenotic level of life organization.

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 7. Biosphere EU is the living shell of the earth, EP is all the phenomena of life that are actively acquired by living organisms.

And all biogeocenoses of the planet make up the earth's biosphere. This is the highest level of organization of living organisms.

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There are levels of life study according to this:

1. Planetary

2. Biogeocenotic

3. Population and species

4. Organizm

5. System

6. Tissue-organ

7. Cellular

8. Subcellular

9. Molecular

10. Submolecular levels of life study are named.

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Cell theory. Types of cellular organization

Cell theory is the idea that the cell is the fundamental structural and functional unit of all living organisms and that new cells are formed from other existing cells. This theory is one of the foundations of modern biology. First formulated in 1838-1839 in the publications of Mathias Jakob Schleiden and Theodor Schwann, the foundations of this theory were laid in the mid-1600s due to advances in microscopy. Today, it is believed that all organisms consist of one or more cells, all vital functions of the body occur within cells, and cells contain inherited information necessary for the regulation of cellular functions and for transmitting information to the next generation of cells.

In the 1850s, Rudolf Karl Virchow promoted cell theory and in 1858 introduced the proposition that "all cells arise from cells". Virchow's contribution complemented classical cell theory. Thus, Virchow is considered one of the authors of cell theory along with Schleiden and Schwann.

In a multicellular organism, each cell is specialized to provide a useful function for the body. In turn, the body provides everything necessary for the survival, growth and maintenance of the cell during its life cycle.

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Classical cell theory

Classical cell theory, developed from observations by Hooke, Leeuwenhoek, Schleiden, Schwann, Virchow, and others, States that:

 All organisms consist of one or more cells.

 Cells are the fundamental functional and structural unit of life.

 Cells of all living organisms are similar in structure and chemical composition

 All cells come from existing cells.

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Modern cell theory

The generally accepted parts of modern cell theory include:

 A cell is a fundamental unit of the structure and functioning of living organisms.

 All cells originate from pre - existing cells by dividing.

 Energy flow (metabolism and biochemistry) occurs inside cells.

 Cells contain inherited information (DNA) that is passed from cell to cell during cell division

 All cells are basically the same in chemical composition.

 All known living things are made up of cells.

 Some organisms are single-celled, consisting of only one cell.

 Other organisms are multicellular, consisting of countless cells.

 The activity of an organism depends on the total activity of an independent cell

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Classification of living things

The globe is home to about 1.5 million species of animals; 500 thousand species of plants; more than 100 thousand species of microorganisms.

Living organism

Non-Cellular Cellular

The Kingdom Of The Viruses Prokaryotes Eukaryotes

Archebacteria Kingdom Of Fungi

Bacteria The Plant Kingdom

Myxomycetes Of The Animal Kingdom

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Objects of biological research

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Prokaryotic and eukaryotic cells have both common structural features and significant differences.

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Prokaryotes

Cell sizes from d 0.05 to 5 microns

Structure of organisms-unicellular and colonial

The genetic material is a ring-shaped DNA molecule in the cytoplasm. The nucleus and chromosomes are missing.

There are few organoids, and there are no double membranes. Ribosomes are smaller.

Eukaryotes

Cell size-d-about 40 microns. The structure of organisms - unicellular, filamentous, multicellular.

Genetic material -a DNA molecule is bound to proteins by histones and forms chromosomes inside the nucleus.

There are many organoids.

1) non-membrane: ribosomes, microtubules, cell center.

2) single-membrane: endoplasmic reticulum, Golgi apparatus, lysosomes.

3) two-membrane: mitochondrias, chloroplasts.

Cell walls-in plants contain cellulose, in fungi-chitin, in animals – are absent.

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The next slide shows a diagram of the structural and functional organization of the eukaryotic cell. We will discuss all the components mentioned here in more detail in practical classes. You should prepare for them using this material.

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Conclusion

Living nature is a heterogeneous, integral system that has its own hierarchical organization.

Man is a part of nature, interconnected with other elements of the organic world.

The mechanisms of evolution cover all levels of life, from molecular to global.

The biological basis of man was formed during phylogeny and reflects the results of evolutionary transformations

The cell is the basic unit of life