



Ministry of Education and Science of Ukraine

BIOLOGY AND ECOLOGY

Curriculum for comprehensive schools

Grades 10-11

Standard level

Grade 10
(70 hours, 2 hours per week)

Expected learning outcomes of the student	Content of study materials
Introduction (approximately 2 hours)	
<p>The knowledgeable component <i>operates with terms and definitions:</i> - system, biosystem, ecosystem, environment, sustainable development of nature and society; refers to: - the main fields of application of biological research; <i>gives examples:</i> - biosystems of different levels; <i>characterises:</i> - features of living material: self-renewal, self-reproduction, self-regulation.</p> <p>The active component <i>distinguishes:</i> - Biosystems of different levels of organisation</p>	<p>Interdisciplinary links between biology and ecology. Levels of organization of biological systems and their interconnections. Fundamental characteristics of living material. Strategy of sustainable development of nature and society.</p>
Subject 1: Biodiversity (approx. 13 hours)	
<p>The knowledgeable component <i>operates with terms and definitions:</i> systematics, nomenclature, classification, phylogenetic systematics, population, viruses, prokaryotes, eukaryotes; <i>identifies:</i> - modern principles of scientific systematics; - hypotheses of origin of viruses; - the ways in which viruses enter cells; <i>gives examples:</i> - viruses, bacteria, unicellular eukaryotes, fungi, plants, animals; <i>characterises:</i> - species criteria; - viruses, prokaryotic organisms, eukaryotic organisms.</p> <p>The activity component: <i>makes up:</i> - the characterisation of species according to species criteria; - comparative characterisation of: viruses, viroids, prions; archaea and bacteria; unicellular and multicellular eukaryotic organisms; <i>classifies:</i> - certain species of fungi, plants, animals; - determines the taxonomic position of species in the system of the organic world.</p>	<p>Systematics is the science of the diversity of organisms. The principles of scientific classification of organisms. Modern criteria of species. Viruses, viroids, prions. Peculiarities of their and their functioning. Hypotheses about the origin of viruses. Interaction of viruses with the host cell and their impact on their functioning. Role of viruses in the evolution of organisms. Use of viruses in biological techniques to control harmful species. Prokaryotic organisms: archaea and bacteria. Peculiarities of their and their functioning. Modern views on the system of eukaryotic organisms. Biodiversity of our planet as a consequence of evolution. <i>Laboratory work</i> Identification of the taxonomic position of a species in the system of the organic world (species chosen by the teacher).</p> <p>An educational project 1. Drawing up a characterisation of a species according to species criteria</p>
Subject 2: Metabolism and energy transformation (approx. 15 hours)	
<p>The knowledgeable component <i>Operates with terms and definitions:</i> metabolism/metabolism, enzyme, vitamin,</p>	<p>Білки, нуклеїнові кислоти, вуглеводи, ліпіди: огляд будови й біологічної ролі. Обмін речовин та енергії – основа функціонування</p>

<p>respiration, autotrophs, heterotrophs, chemotrophs, phototrophs, toxic substances;</p> <p><i>names:</i></p> <ul style="list-style-type: none"> - the structures of the cells that enable metabolic processes; - criteria for drinking water quality; <p><i>gives examples:</i></p> <ul style="list-style-type: none"> - diseases associated with deficiency or excess of ingestion of certain chemical elements, substances; <p><i>characterises:</i></p> <ul style="list-style-type: none"> - peculiarities of the energy metabolism of cells of autotrophic and heterotrophic organisms; - Peculiarities of neutralization of toxic compounds in human organism; - neurohumoral regulation of metabolism in the human body; <p><i>explains:</i></p> <ul style="list-style-type: none"> - unity of the processes of synthesis and decomposition of substances in the organism; - role of ATP in providing metabolic processes; - role of enzymes in providing metabolic processes; - role of individual chemical elements, substances in metabolism; - necessity of deactivation of toxic compounds in the human body. <p>The activity component</p> <p><i>makes up diagrams:</i></p> <ul style="list-style-type: none"> - metabolism of carbohydrates, lipids and proteins in the human body and their interrelationship; <p><i>compares:</i></p> <ul style="list-style-type: none"> - the energetic and plastic value of different substances. 	<p>біологічних систем. Особливості обміну речовин в автотрофних та гетеротрофних організмів.</p> <p>Енергетичне забезпечення процесів метаболізму. Ways in which different groups of autotrophic and heterotrophic organisms produce energy. The role of respiration in the energy supply of organisms.</p> <p>Structures of cells providing metabolic processes.</p> <p>Role of enzymes in ensuring metabolic processes of the cell and the whole organism.</p> <p>Vitamins, their role in metabolism.</p> <p>Metabolic disorders (metabolism) associated with shortage or excess of certain chemical elements, substances. The importance of drinking water quality to preserve human health.</p> <p>Rational nutrition is the basis for normal metabolism. Negative effect of toxic substances on metabolism. Deactivation of toxic compounds in the human body. Neurohumoral regulation of metabolic processes.</p> <p>Practical works</p> <ol style="list-style-type: none"> 1. Making diagrams of metabolism of carbohydrates, lipids and proteins in the human body.
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Subject 3: Heredity and Variability (approx. 20 hours)

<p>The knowledgeable component</p> <p><i>operates with terms and definitions:</i></p> <ul style="list-style-type: none"> - gene, dominant and recessive genes, genome, genotype, phenotype, quantitative and qualitative traits, mono-, di- and polyhybrid crossing, replication, structural and regulatory genes, gene expression, transcription, translation; haploid, diploid and polyploid sets of chromosomes; karyotype, homo- and heterogamous sex; mutagens; mutations (genomic, chromosomal, point mutations); gene pool of populations; <p><i>names:</i></p> <ul style="list-style-type: none"> - modern molecular genetic methods for investigating human heredity (gene sequencing, polymerase chain reaction, use of genetic markers); 	<p>The main concepts of genetics. The law of heredity. Hybridological analysis: main types of interbreeding and consequences.</p> <p>Modern molecular genetic methods of human heredity research.</p> <p>Organization of hereditary material in eukaryotic cell and their realization. Structural and regulatory genes. Regulation of gene activity in eukaryotic cell.</p> <p>Human karyotype and its distinctive features. Chromosome analysis as a method for revelation of karyotype structure abnormalities.</p> <p>Current state of research of human genome. Monogenic and polygenic inheritance of human traits. Extrachromosomal (cytoplasmic) heredity in humans.</p> <p>Regularities of variability (hereditary, non-hereditary) in humans.</p> <p>Mutations and traits. The concept of spontaneous mutations.</p>
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<ul style="list-style-type: none"> - types of mutations; - causes of hereditary human diseases and malformations and human diseases with hereditary predisposition; <p><i>gives examples:</i></p> <ul style="list-style-type: none"> - Human hereditary variability (combinative, mutational); - Human modification variability; <p><i>characterises:</i></p> <ul style="list-style-type: none"> - types of inheritance of traits in humans (complete and incomplete dominance, codominance; autosomal recessive and autosomal dominant, chained, chained with article); - Regularities of human modification variability; - types of human mutations; - mutagenic factors; <p><i>explains:</i></p> <ul style="list-style-type: none"> - application of genetic markers; - The phenomenon of chained inheritance in humans; - Molecular mechanisms of variation in humans; - Biological anti-mutational mechanisms; <p>The activity component</p> <p><i>compares:</i></p> <ul style="list-style-type: none"> - monogenic and polygenic inheritance of traits in humans; - hereditary and non-hereditary variation in humans; <p><i>solves:</i></p> <ul style="list-style-type: none"> - typical tasks in genetics (mono- and dihybrid crossing; complete and incomplete dominance, codominance; sex-linked inheritance); <p><i>defines:</i></p> <ul style="list-style-type: none"> - possible genotypes at a given phenotype (and vice versa); - according to the results of the crossing: which gene is dominant (recessive); type of inheritance of traits; <p><i>makes up:</i></p> <ul style="list-style-type: none"> - charts of pedigrees; <p><i>draws conclusions about:</i></p> <ul style="list-style-type: none"> - the human genotype as a complete integrated system. 	<p>Biological antimutational mechanisms. Protection of human genome from harmful mutagenic influences.</p> <p>Genetic monitoring in communities.</p> <p>Features of the gene pool of human communities and the factors that influence their formation. Regularities of allele distribution in populations.</p> <p>Modern tasks of medical genetics. Hereditary diseases and defects, human diseases with hereditary tendency, their causes. Methods of diagnosis and prevention of human hereditary diseases. Medical genetic counseling and its organization.</p> <p>Laboratory works</p> <p>2. Research the patterns of modification variability.</p> <p>Practical work.</p> <p>2. Solving typical genetic tasks.</p> <p>Project: create a booklet, poster, presentation, book trailer, scribe, etc. (one to choose from)</p> <p>Indicative topics:</p> <p>Genetic monitoring in communities. Screening programmes for newborns. Genotherapy and its perspectives.</p>
<p>Subject 4: Reproduction and development (approx. 12 hours)</p>	
<p>The knowledgeable component</p> <p><i>operates with the terms and definitions:</i></p> <ul style="list-style-type: none"> - mitosis, meiosis, amitosis, regeneration, transplantation, gametogenesis, fertilisation, ontogeny, embryonic induction; <p><i>names:</i></p> <ul style="list-style-type: none"> - Hypotheses of ageing; <p><i>gives examples:</i></p>	<p>Reproduction as a mechanism for ensuring the continuity of species existence.</p> <p>Peculiarities of regeneration processes in the human organism. Transplantation of tissues and organs in humans, its prospects. Bioethics rules.</p> <p>Cell growth and development and the factors influencing it. Cell aging and death. Causes of cell cycle disruption and its consequences.</p>

<p>- cell cycle disorders; <i>explains:</i></p> <ul style="list-style-type: none"> - the significance of regeneration; - the essence and biological significance of fertilisation. <p><i>characterises:</i></p> <ul style="list-style-type: none"> - periods of embryonic and post-embryonic development; <p>The activity component</p> <p><i>makes a comparative characteristic:</i></p> <ul style="list-style-type: none"> - human germ cells; - development of male and female germ cells; <p><i>Demonstrates skills:</i></p> <ul style="list-style-type: none"> - working with a microscope. 	<p>The concept of oncogenic factors and cancer. Prevention of cancerous diseases.</p> <p>Germinal cells. Features of gametogenesis in humans.</p> <p>The essence and biological significance of fertilization. Causes of fertilization disorders in humans. Peculiarities of human reproduction in relation to its biosocial essence. Reproductive health. Modern abilities and perspectives of reproductive medicine. Biological and social aspects of human reproduction regulation.</p> <p>Human embryogenesis. Interaction of parts of the developing embryo (the phenomenon of embryonic induction).</p> <p>Factors that may positively and negatively influence the processes of human growth and development.</p> <p>Laboratory works</p> <ol style="list-style-type: none"> 3. investigating the structure of human germ cells. 4. Study of embryogenesis stages.
<p>Reserve</p>	

Grade 11
(70 hours, 2 hours per week)

Subject 5: Adaptations (approx. 20 hours)

The knowledgeable component

Operates with terms and definitions:

adaptation, pre-adaptation, post-adaptation, adaptive potential, ecological niche, adaptive radiation, co-evolution, co-adaptation, life form, adaptive biological rhythms, photoperiodism

formulates:

- the principle of unity of organisms and habitat;
- the rule of obligatory filling of an ecological niche;

names:

- basic properties of adaptations;
- parameters of ecological niche;
- ways of thermoregulation of organisms;
- basic forms of symbiosis of organisms;
- forms of parasitism;
- types of adaptive biological rhythms of organisms;

gives examples:

- Adaptations of organisms to different habitats;
- Adaptations of humans to different habitats; and
- the adaptive nature of animal behavioural responses;

describes:

- human and other organisms' adaptations to different living conditions;

characterises:

- coadaptations of organisms;
- types of biological rhythms: external and internal, diurnal, monthly, tidal, seasonal, annual, perennial;

explains:

- molecular and cellular mechanisms of adaptation of biological systems;
- the relative nature of adaptations;
- biological basis of Allen's and Bergman's rules;
- the genetic basis of the formation of adaptations.

The activity component:

determines:

- the degree of adaptation of organisms to their environment;

recognises :

- belongs to certain animal and plant species to a certain life form;

compares:

- the thermoregulatory features of a poikilothermic and a homo-thermic animal;
- adaptations of different groups of organisms to a particular habitat;

makes diagrams:

- complexes of adaptations that characterise a particular life form of organisms;

designes:

- consequences of significant overlapping of ecological niches of competing species;

Adaptation as a general property of biological systems. The principle of unity of organisms and environment.

General regularities of adaptation formation. The concept of pre-adaptation and post-adaptation. Properties of adaptation.

Formation of adaptations at the molecular and cellular levels of organization. Adaptation strategies of organisms.

The concept of ecologically plastic and ecologically non-plastic species. The concept of adaptive radiation. Animal and plant life forms as adaptations to habitat.

Ecological niche as a consequence of adaptation of organisms of a particular species to exist in an ecosystem. The concept of conjugate evolution (co-evolution) and co-adaptation.

Main habitats and adaptation of organisms to them.

Methods of thermoregulation of organisms.

Symbiosis and its forms.

Organism as a habitat. Distribution of parasitism among different groups of organisms. Adaptation of parasites to living in the host organism. Response of the host organism to the settlement of parasites.

Adaptive biological rhythms of biological systems at various levels of organization. Types of adaptive biological rhythms of organisms. Photoperiodism and its adaptive significance.

Practical works.

- 1 Identification of signs of adaptability of different organisms to their environment

Subject 6: Biological foundations of a healthy lifestyle (approx. 12 hours)

The knowledgeable component

operates with the terms:

- health, healthy lifestyle, hypodynamia, infectious diseases;

names:

The sciences that study human health.

The principles of a healthy lifestyle. The components of a healthy lifestyle: a healthy diet, physical activity, personal

<ul style="list-style-type: none"> - the sciences that study human health; - the ways of infection by infectious diseases; - factors of non-communicable diseases in humans; <p><i>gives examples:</i></p> <ul style="list-style-type: none"> - preventive measures for human diseases; <p>The activity component</p> <p><i>characterises:</i></p> <ul style="list-style-type: none"> - principles of a healthy lifestyle; - the human immune system and the specifics of its functioning; <p><i>explains:</i></p> <ul style="list-style-type: none"> - mechanisms of antigen-antibody system interaction; - measures for the prevention of human diseases (non-infectious, infectious, invasive, sexually transmitted diseases); 	<p>and domestic hygiene, rest. Safety and sexual culture. Negative effects of alcohol, smoking and drugs on health. Impact of stress factors on the human body. Impact of the environment on human health. Human immune system, peculiarities of its functioning. Immunocorrection. Immunotherapy. Prevention of non-infectious, infectious, invasive diseases, sexually transmitted diseases.</p> <p><i>Practical work.</i></p> <p>2. Development of recommendations for prevention of diseases</p> <p><i>Educational project</i></p> <p>1. personal health promotion programme.</p>
<p>Subject 7: Ecology ((approx. 15 hours.))</p>	
<p>The knowledgeable component</p> <p><i>Operates with terms and definitions:</i> ecology, environmental factors, limiting factors, tolerance, ecological interaction, population, ecosystem, biogeochemical cycles, biosphere, noosphere;</p> <p><i>names:</i></p> <ul style="list-style-type: none"> - ecological laws and their significance; - pathways of energy assimilation, transfer and dissipation in ecosystems; - the main biomes of the Earth; - key biogeochemical cycles; <p><i>gives examples:</i></p> <ul style="list-style-type: none"> - ecological factors and interactions; - types of population interactions in ecosystems; - trophic chains and trophic grids; - regularities of ecosystem formation; <p><i>characterises:</i></p> <ul style="list-style-type: none"> - processes and phenomena in populations, ecosystems and the biosphere; - impact of ecological factors; - principles of application of ecological laws in human activities and their manifestation in nature; - energy flows in ecosystems; - features and properties of ecosystems. <p>The activity component</p> <p><i>identifies:</i></p> <ul style="list-style-type: none"> - elementary cause and effect relationships between ecological processes and phenomena; <p><i>analyses:</i></p> <ul style="list-style-type: none"> - the dependence of organisms on their environment; <p><i>explains:</i></p> <ul style="list-style-type: none"> -the influence of the laws of optimum in nature: -the laws of optimum, mutual compensation of ecological 	<p>The subject of ecology, its objectives and ways of doing things. The links between ecology and other sciences. Ecological laws. Ecological factors and their classification. Regularity of the impact of environmental factors on organisms and their grouping. Steno- and eurybiont species. Population. Classification of populations. Structure and properties of populations. Mechanisms of regulation of the density (density) and number of populations. Functional role of populations in ecosystems. Characteristics and properties of ecosystems. Types of links between populations of different species in ecosystems. Ecological succession as a process of self-development of ecosystems. Causes of succession and types of succession. Laws of succession. Agroecosystems, their structure and peculiarities of functioning. Ways to increase the productivity of agroecosystems. Biosphere as a global ecosystem, its structure and limits. Biogeochemical cycles as a necessary condition for the existence of the biosphere. Vladimir Vernadsky's Theory of the Biosphere and Noosphere and its significance for the avoidance of the global ecological crisis.</p> <p><i>Educational project</i></p> <p>Study of the peculiarities of the structure of local ecosystems (natural or artificial).</p>

<p>factors in nature;</p> <ul style="list-style-type: none"> - regularities of the structures of populations; - causes of unequal biodiversity of ecosystems; - mechanisms of ecological balance of biosphere; - mechanisms of ecological factors action; - mechanisms of integration of ecosystem components; <p><i>makes diagrams:</i></p> <ul style="list-style-type: none"> - biogeochemical cycles; - trophic chains and trophic grids; <p>compares:</p> <ul style="list-style-type: none"> - peculiarities of organisation and functioning of agrocenoses and natural ecosystems. 	
Subject 8: Sustainable development and environmental management (approx. 13 hours)	
<p>The knowledgeable component operates with terms and definitions: sustainable development, ecological thinking, natural resources, environmental management; names: - ecological problems in Ukraine and the world; - types of environmental pollution; - criteria of environmental pollution; - directions of nature protection in Ukraine and in the world; describes: - the ecological state of his region; gives examples of: - of the species that are invasive in his or her region; - sources of environmental pollution; - species included in the Red Book of Ukraine; characterizes: - consequences of environmental pollution for living organisms and humans in particular; - problems of acclimatization and reaclimatization of species; explains: - the need for proper disposal of domestic and industrial waste; - necessity of international cooperation of governmental institutions and public organizations for environmental protection; and - the need for an optimum use of natural resources;</p> <p>The activity component <i>makes a map:</i> - the ecological condition of their region; <i>designs:</i> - ways of disposing of waste; <i>compares:</i> - the degree of pollution of individual territories of Ukraine; <i>applies:</i> - ecological knowledge in everyday activities.</p>	<p>Current environmental problems in the world and Ukraine. Types of pollution, consequences for natural and man-made ecosystems and people. The concept of environmental quality. Criteria of pollution of the environment. Anthropic impact on the atmosphere. Consequences of atmospheric air pollution and its protection. Anthropic impact on the hydrosphere. Causes of violation of natural water quality, water resources deficit, principles of assessment of ecological state of water bodies. Protection of water bodies. Main sources of anthropic soil pollution, consequences. Necessity of soil protection. Anthropic impact on biodiversity. Problems of acclimatisation and reaclimatisation of species. Conservation of biodiversity as a necessary condition for the stability of the biosphere. Environmental policy in Ukraine: environmental legislation, interstate agreements. Red Book and blacklists of animal species. The Green Book of Ukraine. The concept of sustainable development and its significance. Environmental management in the context of sustainable development. The concept of ecological thinking. The need for international cooperation in environmental protection.</p> <p><i>Practical work.</i> Assessment of the ecological state of their region.</p>
Subject 9: Applications of biological research results in medicine, selective breeding and biotechnology (15 hours approximate)	