# ALIVE - Make Biology Fun with Virtual Reality

# IO1 – Curriculum and Innovative Learning Material for Biology

**ERASMUS + 2020-1-SK01-KA201-078297**

**Strategic Partnerships for school education**

**Cooperation for innovation and the exchange of good practices**

# CONTENTS

# INTRODUCTION

Biology, as the subject in elementary school, is focused on learning about phenomena and processes taking place in nature in mutual contexts and leads students to understand nature as a whole. It focuses mainly on those phenomena that directly affect human life. Their knowledge is the starting point for forming a positive relationship with nature, developing the ability to think and act ecologically, as well as for strengthening habits important for maintaining health.

**Curriculum and Innovative Learning Material for Biology** not only determine performance and content but also enables the development of individual learning opportunities for each student. It designs and formulates effective and modern tools for Biology courses or lessons. It is based on a detailed analysis of needs concerning the possibilities of virtual worlds.

The basic learning objectives are specified in the performance standard. It is a comprehensive system of performances, which are expressed by graded concrete goals called learning requirements. These basic requirements can be further specified, concretized, and developed by teachers in the form of other close learning goals, learning tasks, questions, or test items.

A content standard is assigned to the defined performances, in which the curriculum is divided according to five thematic courses (subsequently virtual worlds):

- World of plants (12 teaching hours – TH)
- Microbiology (13 TH)
- World of living animals (12 TH)
- Living environment (13 TH)
- Human body (13 TH)

The teacher can creatively modify and classify the learning content according to individual grades or forms of teaching and learning. The goal is for the teacher to not only present students with ready-made knowledge but to create appropriate conditions for them to actively acquire knowledge. It creates a virtual space that allows students to manipulate specific objects, observe phenomena, and conduct experiments, but also discuss with each other and solve open tasks, and practical or theoretical problems. The basic approaches of the **ALIVE**

**Curriculum and Innovative Learning Material for Biology** focus on student´s discovery, research, and investigation.

Students, in a game-based playful way in thematic virtual worlds:

- understand natural phenomena, processes, and objects in mutual contexts,

- obtain information about nature by observing, searching, investigating, and using various sources,
- analyze, interpret, sort, and evaluate information about organisms and nature,
- use the correct terminology to describe processes and phenomena in living and non-living nature,
- plan, carry out, record, and evaluate simple biological observations and experiments, protect nature and save natural resources,
- plan and implement simple projects in the field of biology.

Part of the curriculum is a detailed description of individual courses, including specific content and appropriate didactic methods. The learning materials are made up of a series of presentations, and multimedia content that forms the theoretical basis of innovative 3D educational activities, and areas of the 3D virtual world, including exercises, quizzes, or terminological activities. Educational scenarios, as an inseparable component of ALIVE educational material, take place in a virtual environment and cover the general educational functionality of the 3D world as well as specific interactive 3D activities associated with each educational concept.

# 1 GENERAL OVERVIEW

**Course description**:

All the courses should be dynamic in nature, since Biology / Natural Sciences teachers have the necessary prior knowledge for their development. Only a few theoretical basics will be remembered and activities will be developed based on these notions. The aim is to provide learning in a more informal way, however, provided with extensive content and effective solutions for practical use in a school context.

**EOF: 1 - 2**

**Mode of delivery**: Face to face for theory is essential because the learning modules are dynamic and therefore the added value of being in a group should be used. Reading material in form of online presentations will be provided so teacher can invite participants to use it for self-study or online learning within a group.

**Recommended learning activities and teaching methods:**

- concept / mind mapping,
- brainstorming,
- questioning,
- groupwork,
- discussions,
- experience based learning / observation / experiment.

**Assessment methods**: a continuous evaluation will be made according to the participation of the trainees through:

- online learning activities / online test and quizes,
- Living labs activities in virtual world,
- Assessment and general assessment activities in virtual world,,
- papers, projects, presentations
- portfolio.

## 2 COURSE TITLE: WORLD OF PLANTS (SAS)

**Learning outcomes of the course unit:**

The theoretical objectives:

- Understand the way plants produce essential organic matter and the importance of chlorophylls in plants;
- Understand the distribution of plants based on their diet and understand the basic relationships between organisms (positive, negative and neutral);
- Be able to distinguish parts of plants (root, stem, leaf, flower) and characterize their main function (eg nutrient uptake, photosynthesis, reproduction);
- Know the methods of plant propagation, understand their advantages and disadvantages and be able to give examples of their practical use.

The practical objectives:

- Recognize the importance of plants as essential oxygen producers;
- On the basis of the acquired knowledge to be able to understand the importance of water for plants and to be aware of the negative manifestations of its scarcity;
- Ability to use information and communication technologies and resources in obtaining and processing information, as well as the presentation of their own work.

**Course content:**

1) **Photosynthesis**
2) **Plant´s respiration**
3) **Movement of water in plants and nutrition of plants**
4) **Reproduction of plants**

Recommended or required reading:

https://biopedia.sk/rastliny/rastlinne-pletiva
https://oskole.detiamy.sk/clanok/vyziva-a-dychanie-rastlin
https://www.ta3k.sk/biokutik/index.php/rastlinypp/95-fyziologia-rastlin/102-vodny-reim-rastlin
https://siov.sk/wp-content/uploads/2019/02/Metodicky-manual-pre-predmet-Biologia.pdf
http://www.biomach.cz/biologie-rostlin/vodni-rezim-rostlin
https://ostrava.educanet.cz/www/biologie/indexab33ab33.html?option=com_content&view=article&id=121&Itemid=121

http://docplayer.sk/190233178-8-t%C3%A9ma-vodn%C3%BD-re%C5%BEim-rastl%C3%ADn.html
http://planetavedomosti.iedu.sk/index.php/resources/cievny_zvazok_drevna_cast_faktory_koren_listy_osmoza_poda_prechod_vody_prenos_rastliny_rovnovaha_rychlost_transpiracie_stavba_korena_listov_transpiracia_transpiracny_prud_voda_vplyv_osmozy_t_page0.html
https://oskole.detiamy.sk/clanok/vodny-rezim-rastlin
https://www.ta3k.sk/biokutik/index.php/rastlinypp/95-fyziologia-rastlin/98-metabolizmus-rastlin
https://sk.wikipedia.org/wiki/Saprofytizmus
http://www.biomach.cz/biologie-rostlin/fotosynteza
http://www.biomach.cz/biologie-rostlin/rozmnozovani-rostlin
https://ostrava.educanet.cz/www/biologie/indexc642c642.html?option=com_content&view=article&id=119&Itemid=119
https://ostrava.educanet.cz/www/biologie/index34483448.html?option=com_content&view=article&id=120&Itemid=120
https://ostrava.educanet.cz/www/biologie/indexa8e5a8e5.html?option=com_content&view=article&id=123&Itemid=123
https://oskole.detiamy.sk/clanok/stavba-tela-kvitnucich-rastlin-koren-14120
https://oskole.detiamy.sk/clanok/vyziva-a-dychanie-rastlin
https://www.ta3k.sk/biokutik/index.php/rastlinypp/95-fyziologia-rastlin/100-fotosynteza
https://www.ta3k.sk/biokutik/index.php/rastlinypp/95-fyziologia-rastlin/101-dychanie
https://www.ta3k.sk/biokutik/index.php/rastlinypp/95-fyziologia-rastlin/104-rozmnoovanie-rastlin
https://biopedia.sk/ekologia/medzidruhove-vztahy

| Learning unit 1:<br>**Photosynthesis**<br>(definition, principle, importance of photosynthesis, importance of chlorophyll and chloroplast) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Photosynthesis**<br>**Importance of photosynthesis**<br>**Chloroplast**<br>**Chlorophyll**<br>**Solar energy**<br>**Energy in the plant**<br>**The importance of leaves for the plant** | **At the end of the course a student can:**<br>– know the definition of photosynthesis<br>– explain what is chloroplast and its role in the plant<br>– explain the concept of chlorophyll and its role in the plant<br>– know how the plant forms storage substances - energy<br>– know the example of a single-celled organism that obtains nutrients through photosynthesis<br>– know the principle of photosynthesis<br>– know the importance of photosynthesis for organisms .<br>– be able to describe in which parts of plants photosynthesis takes place<br>– know the resulting products of photosynthesis and briefly describe their origin |

| **Learning unit 2:**<br>**Plants respiration**<br>(principle, cellular respiration, vents) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Plant respiration,**<br>**Respiration**<br>**Anaerobic respiration**<br>**Aerobic breathing**<br>**Water regime**<br>**Assimilation and transpiration current**<br>**Transpiration Vents**<br>**Photosynthesis and respiration**<br>**Leaf of a plant**<br>**Temperature and respiration** | **At the end of the course a student can:**<br>– analyze and evaluate the basic principles of plant respiration<br>– explain the importance of breathing<br>– be able to explain the terms breathing, transpiration, respiration, gutting<br>– explain the importance of individual parts of the plant in respiration<br>– characterize respiratory conditions<br>– characterize the difference between breathing during the day and at night<br>– compare and explain the differences between aerobic and anaerobic respiration<br>– compare and contrast photosynthesis and respiration<br>– know what the vents are and explain their role in breathing,<br>– be able to explain the effect of temperature on plant respiration |

**Learning unit 3:**

## Movement of water in plants + nutrition of plants

(water intake and transport of water and nutrients, classification of plants according to their nutrition –autotrophs, heterotrophs, importance of water)

**Teaching hours: 3**

| Content | Performance |
|---|---|
| **The importance of water**<br>**Water and nutrient intake**<br>**The root and its structure**<br>**Vascular bundles**<br>**Transport of water and nutrients**<br>**Water supply**<br>**Heterotrophy**<br>**Autotrophy**<br>**Saprophyte**<br>**Symbiosis**<br>**Parasitic plant**<br>**Semi-parasitic plant** | **At the end of the course a student can:**<br>– define why water is necessary for plants<br>– describe the basic manifestations and effects of water scarcity in the plant<br>– explain the concept of diffusion and osmosis<br>– characterize the basic structure and function of the root<br>explain what the vascular bundles are and describe their condition (wood, lyko)<br>– recognize the direction in which water and nutrients taken up by the root (transpiration stream) and organic substances formed during photosynthesis (assimilation stream) are transported in the plant<br>– explain how the plant excretes excess water<br>– define and divide plants according to the way they are fed into heterotrophic and autotrophic<br>– characterize relationships between organisms (positive, negative, neutral)<br>– describe which plants are parasitic and semi-parasitic, he will also be able to give examples<br>– explain the term - saprophyte and also give an example of such a plant |

| Learning unit 4:<br>**Reproduction in plants**<br>(Sexual/Asexual) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Plant propagation function**<br>**Methods of plant propagation**<br>**Sexual reproduction of plants**<br>**Flower construction**<br>**Pollination**<br>**Fertilization**<br>**Seeds**<br>**Fruit**<br>**Asexual reproduction of plants** | **At the end of the course a student can:**<br>– explain the importance of plant reproduction<br>– define the basic methods of plant reproduction<br>– explain the origin of the flower and its importance in the sexual reproduction of plants<br>– describe the structure of the flower - explain what pollination is<br>– differences between self-pollination and foreign pollination<br>– state how pollination is carried out (which are the most important pollinators)<br>– explain the nature of fertilization - define what a seed is and its importance in the reproductive cycle of plants<br>– describe how the fruit is formed and what its role is in plant reproduction - give a basic breakdown and examples of fruits and edible explain how asexual reproduction of plants takes place<br>– list the methods of asexual reproduction of non-flowering and flowering plants together with examples |

## 3 COURSE TITLE: MICROBIOLOGY (SAS)

**Learning outcomes of the course unit:**

The theoretical objectives:

- Know the importance of bacteria and viruses;
- Know the basic structure, functions and vital manifestations of plant and animal cells, unicellular and multicellular organisms;
- Know the nature and importance of heredity in nature and for humans

The practical objectives:

- Be able to give examples of viral and bacterial diseases. Also understand the difference between harmful and beneficial bacteria and be able to give an example of beneficial bacteria (symbiotic, fermentation decomposition);
- Using examples of simple attempts to understand the principle of diffusion (tea bag) and osmosis (potato);
- Based on the acquired knowledge, be able to recognize plant and animal cells and identify individual cell organelles in the picture;
- Use good practices and techniques in practical activities, follow safety and health rules, use teaching, compensatory and other aids, develop skills in working with natural products and in observations;
- Apply theoretical knowledge and experience in practical conditions.

**Course content:**

1) **Osmosis, diffusion, mitosis, meiosis**
2) **Influence of microorganisms on human life and the environment (viruses and bacteria)**
3) **Basics of genetics**
4) **Cells as a basic building unit**

Recommended or required reading:

https://biopedia.sk/bunka
https://biopedia.sk/bunka/organizacia-bunky
https://biopedia.sk/bunka/eukaryoticka-bunka
https://biopedia.sk/bunka/bunkova-stena
https://biopedia.sk/bunka/biomembrany
https://biopedia.sk/bunka/zakladna-cytoplazma
https://biopedia.sk/bunka/jadro
https://biopedia.sk/bunka/mitochondrie

https://biopedia.sk/bunka/plastidy
https://biopedia.sk/bunka/prijem-a-vydaj-latok
https://biopedia.sk/bunka/mitoza
https://biopedia.sk/bunka/meioza
https://www.ta3k.sk/biokutik/index.php/bunka/46-truktura-eukaryotickej-bunky
https://www.ta3k.sk/biokutik/index.php/bunka/49-veobecna-charakteristiky-prokaryotickej-bunky
https://www.ta3k.sk/biokutik/index.php/bunka/50-bunkovy-cyklus
https://www.ta3k.sk/biokutik/index.php/bunka/86-prijem-a-vydaj-latok-bunkou
https://oskole.detiamy.sk/clanok/struktura-bunky
https://e-ucebnice.sk/stare/e-ucebnice/biologia6naWelp/rastlinn_a_ivona_bunka.html
https://e-ucebnice.sk/stare/e-ucebnice/biologia6naWelp/jednobunkov_organizmy.html
https://e-ucebnice.sk/stare/e-ucebnice/biologia6naWelp/mnohobunkov_organizmy.html
https://biopedia.sk/genetika/zakladne-geneticke-pojmy
https://www.ta3k.sk/biokutik/index.php/genetika/87-genetika/106-zakladne-pojmy
https://www.ta3k.sk/biokutik/index.php/genetika/87-genetika/108-geneticka-informacia-geneticky-kod
https://www.ta3k.sk/biokutik/index.php/genetika/87-genetika/110-bunka-a-dedinos
https://www.ta3k.sk/biokutik/index.php/genetika/88-autozomova-dedinos/112-dedinos-u-mnohobunkovych-organizmov
https://www.ta3k.sk/biokutik/index.php/genetika/88-autozomova-dedinos/113-krienie-hybridizacia
https://www.ta3k.sk/biokutik/index.php/genetika/88-autozomova-dedinos/116-dedinos-kvalitativnych-znakov
https://www.ta3k.sk/biokutik/index.php/genetika/90-geneticka-premenlivos/118-geneticka-premenlivost
http://www.genetika-biologie.cz/genetika-obecne

| Learning unit 1:<br>**Osmosis, diffusion, mitosis, meiosis**<br>(characteristics, definitions, process) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Cell function**<br>**Cellular transport**<br>**Diffusion**<br>**Osmosis**<br>**Single-cell and multi-cell structures**<br>**Cell division - mitosis**<br>**Stages of mitosis**<br>**Meiosis** | **At the end of the course a student can:**<br>– explain the importance of cells for life<br>– each cell is like a microscopic factory<br>– describe cellular transport<br>– main methods<br>– explain the concept of diffusion and describe its course<br>– explain the concept of osmosis and describe its course, or examples (withered flowers in a vase)<br>– give examples of differences between unicellular and multicellular organisms<br>– explain the concepts of tissues and tissues<br>– describe how the number of cells increases<br>– define mitosis<br>– describe the various stages of mitosis<br>– define meiosis and the basic difference between mitosis and meiosis |

| **Learning unit 2:**<br>**Influence of microorganisms on human life and the environment**<br>(virus and bacteria) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Microorganisms**<br>**Bacteria - body structure, division**<br>**Mushrooms - characteristics, distribution**<br>**Microorganisms living with humans**<br>**Pathogens - definition, classification**<br>**Viruses - characteristics, body structure**<br>**Diseases caused by bacteria and viruses**<br>**Disease protection** | **At the end of the course a student can:**<br>– define micro-organisms<br>– organisms that do not belong to animals or plants<br>– characterize the bacteria and describe their body structure<br>– define mushrooms and describe their distribution<br>– give examples where we encounter microorganisms in everyday life<br>– give examples of bacteria, yeasts with a positive effect<br>– explain what pathogens are and what they cause<br>– characterize viruses and describe their body structure<br>– give examples of diseases caused by bacteria and their treatment<br>– give examples of viral diseases and describe possible ways of entering the body - the most serious viral disease today<br>– explain the basic methods of protection against viral and bacterial diseases |

| **Learning unit 3:**<br>**Basic of Genetics**<br>(heredity, gene, crossing, principles) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Genetics**<br>**Inheritance**<br>**Variability - hereditary and non-hereditary**<br>**Genetic information**<br>**Chromosome**<br>**Nucleic acid and DNA**<br>**Gene**<br>**Character and property**<br>**Allele - dominant and recessive**<br>**Crossing and crossing scheme**<br>**Breeding**<br>**Body and germ cell**<br>**Hereditary disease** | **At the end of the course a student can:**<br>– describe the manifestations of heredity<br>– name the part of the cell in which the genetic information is stored<br>– explain the importance of nucleic acids in the transmission of genetic information<br>– describe the structure of the chromosome<br>– know the importance of reducing the number of chromosomes in the formation of germ cells<br>– understand the cause of nucleic acid copying before cell division<br>– know the meaning of the terms allele, gene and trait<br>– describe according to the crossing scheme, the emergence of a certain trait of a new individual<br>– know the meaning of variability<br>– distinguish between non-hereditary and hereditary variability<br>– give an example of organism variability<br>– describe the nature of breeding, give an example of a plant variety or animal breed<br>– give an example of the impact of hereditary disease on human life |

| **Learning unit 4:**<br>**CELL as a basic building unit**<br>(definition, differences between plant and animal cells, cell division) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Cell**<br>**Cell organelles**<br>**Organism - single-celled and multicellular**<br>**Plant cell**<br>**Animal cell**<br>**Mesh**<br>**Tissue**<br>**Cell division** | **At the end of the course a student can:**<br>– know the importance of the cell for organisms<br>– know the structure, function and life manifestations of cells<br>– characterize individual parts of the cell and their functions<br>– distinguish between living and inanimate cell components<br>– compare the features and functions of plant and animal cells<br>– justify the differences in plant and animal cell structure<br>– define the difference between tissue and tissue and give examples<br>– observe the cells under a microscope<br>– define the differences between a single-celled and a multicellular organism<br>– name the parts of the cell that provide respiration, photosynthesis, and protein production<br>– distinguish between active and passive cell movement<br>– describe the cell division on the diagram |

## 4 COURSE TITLE: WORLD OF LIVING ANIMALS (UCY)

**Learning outcomes of the course unit:**

Theoretical objectives:

- Understand and explain the process of evolution of species by recognizing and justifying the changes that occur in species characteristics over time and the influence of the environment.
- Develop the ability to recognise that groups of species traditionally considered harmful can be very important by realising their key roles in maintaining the health of ecosystems or even be used in practical applications.
- Understand that reproductive strategies used by different animals can be shaped by environmental factors.

Practical objectives:

- Provide background knowledge, and skills that can help resolve common misconceptions with regards to evolution,
- Develop the ability to view biological species (including human) in the context of (evolutionary) time and (ecological) space.
- Recognise and be able to communicate the important impact of insects in ecosystems and in human-related activities/applications.
- Understand threats posed by parasites and become able to recognize ways to overcome them at the personal, community, and global level.
- Recognize and develop the ability to adopt personal hygiene measures that contribute towards maintaining the health of the reproductive system.

**Course content:**

1) **Evolution**
2) **The importance of insects for life on Earth**
3) **Parasites**
4) **Reproduction in animals**

Recommended or required reading:

https://www.stem.org.uk/resources/community/collection/12648/year-6-evolution-and-inheritance
https://www.sensoryecology.com/games/
https://evolutionforprimarykids.co.uk/common-misconceptions/
https://www.teachingpacks.co.uk/guides/evolution/
https://flexbooks.ck12.org/cbook/ck-12-middle-school-life-science-2.0/section/9.15/primary/lesson/insects-ms-ls/
https://www.entsoc.org/sites/default/files/files/Pollinator%20Directions.pdf
https://pollinatorlive.pwnet.org/index.php
https://www.onegreenplanet.org/animalsandnature/why-bees-are-important-to-our-planet/#
https://www.entsoc.org/sites/default/files/files/education-outreach/enlist_introduction.ppt
https://www.entsoc.org/sites/default/files/files/education-outreach/enlist_handout.pdf
https://www.entsoc.org/sites/default/files/files/education-outreach/Lessons_ABCs.pdf
https://www.tweentribune.com/article/tween56/are-zombees-doomsday-bees/
https://www.carolina.com/teacher-resources/Interactive/insects-friends-or-foes-the-many-roles-of-beneficial-insects/tr40221.tr
https://www.nrdc.org/sites/default/files/bee-deaths-FS.pdf
https://naturalhistory.si.edu/education/teaching-resources/life-science/living-together-parasites-and-hosts
https://www.cdc.gov/parasites/about.html
https://www.cdc.gov/parasites/transmission/index.html
http://ebooks.edu.gr/ebooks/v/html/8547/2250/Biologia_A-Gymnasiou_html-empl/index6_1.html
https://www.treehugger.com/animals-that-reproduce-asexually-5112566
https://www.pbslearningmedia.org/resource/tdc02.sci.life.repro.asexual/asexual-reproducers/
https://opentextbc.ca/biology/chapter/13-1-how-animals-reproduce/
https://opentextbc.ca/biology/chapter/13-2-development-and-organogenesis/
https://opentextbc.ca/biology/chapter/13-3-human-reproduction/

| **Learning unit 1:**<br>**Evolution**<br>(principle, natural and artificial selection) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Definition of evolution.**<br>**Variation.**<br>**Adaptation.**<br>**Natural selection.**<br>**Artificial selection.**<br>**Environmental requirements.**<br>**Survival.**<br>**Species extinction.**<br>**Common ancestor.**<br>**Evidence for the theory of evolution.** | **At the end of the course a student can:**<br>– explain the term *evolution*<br>– understand that extant living organisms are the product of evolution of previous organisms<br>– identify similarities and differences in the characteristics of a species in different time periods<br>– correlate significant changes in the characteristics of particular species over time (evolutionary process) with changes in the conditions and requirements of their environment<br>– explain the process of adaptation and its role in the evolution of species (survival of offspring with specific characteristics)<br>– describe cases of species extinction due to inability to adapt to changes in the environment<br>– describe evidence supporting the theory of evolution |

| Learning unit 2:<br>**The importance of insects for life on Earth**<br>(Significant harmful insects - Bees and pollinators) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Definition of insects.**<br><br>**Insect anatomy and physiology.**<br><br>**Insect behaviour.**<br><br>**Insects as pests.**<br><br>**Useful insects.**<br><br>**Insects and practical applications.**<br><br>**Endangered insects.** | **At the end of the course a student can:**<br>– identify insects among other species (e.g. spiders, isopods)<br>– identify the defining anatomical features of insects<br>– understand the analogy in anatomical features of insects with those of other animals,<br>– describe the basic features of the insect nervous, respiratory, digestive and circulatory system<br>– describe types of insect movement and communication<br>– understand that insects can have advanced social behaviour<br>– explain why insects are often seen as pests by humans<br>– understand why insects are of key importance for the ecosystem<br>– describe positive impact of insects in activities/applications (e.g. economy, food production, biotechnology)<br>– understand the undesired effects resulting from the extinction of particular insect species |

| **Learning unit 3:**<br>**Parasites**<br>(definition, principle, animal and plant parasites) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Symbiosis (mutualism, commensalism and parasitism).**<br><br>**Parasites (and their hosts) can be of all sizes, "colors" and "shapes".**<br><br>**Parasites and human health.**<br><br>**Animal (and livestock) parasites.**<br><br>**Parasites in (agricultural) plants.**<br><br>**Parasites in applications.** | **At the end of the course a student can:**<br>– define a symbiotic relationship<br>– understand the differences between different forms of symbiotic relationships<br>– list and describe examples of symbiotic relationships in nature<br>– differentiate between predator-prey and host-parasite relationships<br>– describe examples of animal, plant, fungal and protozoan parasites<br>– identify parasites that parasitise animal and plant hosts<br>– give examples of parasites that can make us sick<br>– understand the negative impact of parasites in economically important animals and plants<br>– describe uses of parasites in applications |

| Learning unit 4:<br>**Reproduction in animals**<br>(sexual / asexual) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Monogony vs Amphigony.**<br><br>**Asexual vs Sexual.**<br><br>**Gametes.**<br><br>**Zygote.**<br><br>**Oviparous and viviparous vertebrates.**<br><br>**Components of the human reproductive system.**<br><br>**Hormones.** | **At the end of the course a student can:**<br>– recognise the importance of reproduction for the perpetuation of species<br>– distinguish sexual from asexual reproduction in animals<br>– describe (roughly) reproduction in key invertebrate species<br>– distinguish between the different stages of metamorphosis of key insects<br>– explain the difference of internal versus external fertilisation<br>– identify and justify the impact of environmental factors in the reproductive behaviour of vertebrates<br>– describe the structure of human (male and female) reproductive system<br>– distinguish the distinct roles of gametes<br>– describe the phases of the menstrual cycle<br>– describe fertilization, embryogenesis<br>– embryonic development and birth<br>– recognize environmental factors affecting pregnancy<br>– identify and justify body changes happening during puberty |

## 5 COURSE TITLE: LIVING ENVIRONMENT AND LIVING ORGANISMS (ZS BENKOVA 34)

**Learning outcomes of the course unit:**

The theoretical objectives are to:

- understand, analyze and evaluate the relations between man and his environment based on knowledge of the laws governing life on Earth,
- develop the ability to understand the links between local and global issues and to adopt one's responsibility concerning the environment,
- develop a sense of individual responsibility for man's relationship to the environment as a consumer and producer.

The practical objectives are to:

- provide knowledge, skills, and habits that are necessary for everyday actions and human attitudes to the environment,
- develop cooperation in the protection of the environment at the local, regional and international levels,
- be able to assess the objectivity and relevance of information on the state of the environment and communicate about it, rationally justify one´s views and opinions,
- develop the ability to use information and communication technologies and resources in obtaining and processing information, as well as the presentation of their own work.

**Course content:**

1) **Biodiversity**
2) **Climate change – its impact on ecosystems**
3) **Water cycle and water movements**
4) **Ecological pyramid**
5) **Natural resources and Sustainability**

Recommended or required reading:

https://ec.europa.eu/environment/basics/global-challenges/consequences/index_sk.htm
http://www.shmu.sk/sk/?page=1069
https://vedanadosah.cvtisr.sk/priroda/zem/klimaticke-zmeny-vo-svete-co-nas-caka-a-neminie/
https://www.consilium.europa.eu/sk/policies/climate-change/
https://ecohero.sk/globalne-oteplovanie/
https://sk.wikipedia.org/wiki/Ekologick%C3%A1_pyram%C3%ADda
https://sk.wikipedia.org/wiki/Ekosyst%C3%A9m
https://biopedia.sk/ekologia/ekosystem
https://referaty.centrum.sk/prirodne_vedy/biologia_a_geologia/34011/
https://oskole.detiamy.sk/clanok/ekosystem-i
https://www.minzp.sk/files/sprievodca-neformalnou-environmentalnou-vychovou-slovensku.pdf

https://stromzivota.sk/storage/public_projects/tajomna-energia-zdroje-energie-1570111905.pdf
https://issuu.com/menobodkapriezvisko/docs/8_rocnik_final
https://issuu.com/menobodkapriezvisko/docs/environmenta__lna_vy__chova_-_metod_b598d572721418
https://ecohero.sk/neobnovitelne-zdroje-energie/
https://ecohero.sk/obnovitelne-zdroje-energie/
https://oskole.detiamy.sk/clanok/obnovitelne-prirodne-zdroje-slnecna-energia
https://oskole.detiamy.sk/clanok/obnovitelne-prirodne-zdroje-veterna-energia
https://oskole.detiamy.sk/clanok/biomasa-ako-palivo
https://oskole.detiamy.sk/clanok/biomasa
https://oskole.detiamy.sk/clanok/geotermalna-energia
https://oskole.detiamy.sk/clanok/tazba-nerastnych-surovin-a-zivotne-prostredie
https://ec.europa.eu/environment/nature/info/pubs/docs/brochures/biodiversity_tips/sk.pdf
http://www.lipka.cz/soubory/mameNazemi_web.pdf
https://www.minzp.sk/files/sprievodca-neformalnou-environmentalnou-vychovou-slovensku.pdf

| **Learning unit 1:**<br>**Biodiversity**<br>(characteristics, how is it caused, importance) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Biodiversity-definition.**<br>**Levels of biodiversity.**<br>**Species diversity.**<br>**Functions of biodiversity.**<br>**Protection of biological diversity.** | **At the end of the course a student can:**<br>– explain the term *biodiversity*<br>– distinguish levels of biodiversity and describe them shortly<br>– justify relations in the ecosystem<br>– give examples of species diversity in nature<br>– name and describe functions of biodiversity<br>– distinguish ecosystem services and their importance<br>– define the influence of human activity on nature<br>– explain basic principles of nature, country, and biodiversity protection |

| **Learning unit 2:**<br>**Climate change and its impact on ecosystems**<br>(causes, effects, manifestations) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Ecosystem.**<br>**Types and components of an ecosystem.**<br>**Organisms of an ecosystem.**<br>**Climate.**<br>**Climate change.**<br>**Greenhouse effect.**<br>**Global warming.**<br>**Ecological burden.**<br>**Negative human activity.**<br>**Globalization.** | At the end of the course a student can:<br>– define an *ecosystem* as a basic unit of nature<br>– describe the structure and functions of the ecosystem<br>– distinguish positions and importance of different living organisms in the ecosystem<br>– explain a term *climate* and give examples of climate types<br>– explain the term *climate change*<br>– give examples of different human activities which contribute the most to environmental pollution (agriculture, industry, transport)<br>– identify and give examples of activities and processes causing the accumulation of carbon dioxide and other pollutants in the ai<br>– explain the principle of the greenhouse effect,<br>– state climate changes and the consequences of the greenhouse effect on living and non-living nature |

| **Learning unit 3:**<br>**Water circle and water movements**<br>(States of water in nature, water movements, importance, and causes) | |
|---|---|
| **Teaching hours: 2** | |
| **Content** | **Performance** |
| **States of water.**<br>**Changes in the states of water.**<br>**Dew point.**<br>**Water cycle.**<br>**Acid rain.**<br>**(low) tides – tidal phenomenon.**<br>**Gravitation.** | **At the end of the course a student can:**<br>– distinguish individual states of water<br>– explain the terms evaporation and condensation<br>– model the formation of rain<br>– describe the water cycle<br>– give examples of the human activities with a negative impact on the water cycle<br>– explain the term *acid rain*<br>– analyze the possibilities of preventing the acid rains formation<br>– describe the gravitational action of the Moon and the Sun on the ocean surface<br>– give examples of how the water cycle affects the life of an ecosystem |

| **Learning unit 4:**<br>**Exploring ecological pyramid**<br>(ecological stability, elaboration of data, ...) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Ecosystem.**<br>**Biocenosis.**<br>**Biotope.**<br>**Producer.**<br>**Consumer.**<br>**Reducer.**<br>**The flow of substances and energy in the ecosystem.**<br>**Food chain.**<br>**Ecological (food chain) pyramid.**<br>**Ecological stability.** | **<u>At the end of the course a student can:</u>**<br>– define an *ecosystem* as a basic unit of nature<br>– justify the functioning of the ecosystem concerning the flow of energy and substances<br>– distinguish terms *producer, consumer, reducer*<br>– give examples of different food chain types<br>– describe the structure of *ecological (food chain) pyramids* using a picture of the pyramid<br>– explain the term ecological stability<br>– justify the importance of sunlight to energy flow in nature<br>– find food chains in nature by observing and insert them into the food chain pyramid<br>– explain the need for maintaining ecological stability within an ecosystem. |

| Learning unit 5:<br>**Natural resources and sustainability**<br>(definitions, importance, natural resources protection) | |
|---|---|
| **Teaching hours: 2** | |
| **Content** | **Performance** |
| **Natural resources.**<br>**Non-renewable natural resources.**<br>**Renewable natural resources.**<br>**Use of alternative energy sources.**<br>**Sustainability.**<br>**Rational use of natural resources concerning sustainable development.**<br>**Natural resources protection.** | **At the end of the course a student can:**<br>– distinguish separate natural resources and describe them<br>– understand the importance of natural resources and the global interconnections of contexts affecting the state of natural resources<br>– differentiate between their rights and obligations regarding the protection of resources<br>– understand their own responsibility for the state of the environment<br>– apply practical habits to the rational use of natural resources<br>– give examples of environmental problems on local, regional, national, and global character and importance |

## 6 COURSE TITLE: HUMAN BODY + HEALTH PROTECTION (CCOV)

**Learning outcomes of the course unit:**

Theoretical objectives:

- Understand and explain the structure and function of the organs of the respiratory system.
- To develop the ability to recognize the upper and lower airways, to understand the mechanism of breathing and the principles of external and internal breathing.
- Recognize the harmful effects on the respiratory system and the factors and consequences of polluted air. The harmfulness of smoking and inhaling toxic substances.
- Understand the concept of blood and understand its meaning. Know the components of blood and their properties, blood groups. Understand the meaning and function of blood vessels. Understand the importance of blood and the consequences of its loss.
- Understand the structure and operation of the heart, blood circulation. External manifestations of heart activity.
- Understand the nervous system, its meaning and function. Be able to identify nerve cells and nerves. Know the concept of reflex.

Practical objectives:

- to provide basic knowledge and skills that can help to understand the functions of the main parts of the respiratory system.
- to describe the exchange of respiratory gases in the lungs, explain the essence of breathing. Recognize the external and internal breathing. Determine the movements of the diaphragm and intercostal muscles by observing inhalation and exhalation.
- To determine the components of blood on a sample and explain their meaning. Name the blood groups.
- to mark and name the parts of the heart, to understand the importance of the heart valves for the activity of the heart.
- To understand the meaning of artery, vein and capillary. Know the importance of coronary arteries. Recognize difference between arteries and veins according to the direction of blood flow. Know the meaning of sap, sap vessels and lymph nodes.
- To understand the basic properties of the nerve cell and the meaning of nerves, the course of the reflex arc and the basic parts of the central nervous system, the basic structure of the peripheral nervous system and their meaning.

**Course content:**

1) **Circulatory system + Blood types**
2) **Nervous system**
3) **Respiration system**
4) **How can nutrition influence the functioning of organism?**
5) **Defense functions of the organism (How does the immune system work?)**

Recommended or required reading:

https://cs.wikipedia.org/wiki/Ob%C4%9Bhov%C3%A1_soustava
http://www.nabla.cz/obsah/biologie/kapitoly/biologie-cloveka/obehova-soustava-cloveka.php
https://www.ucseonline.cz/biologie/obehova-soustava-cloveka/
https://www.youtube.com/watch?v=1Z3nSM0Kfms
https://oskole.detiamy.sk/clanok/obehova-sustava-9471
https://www.youtube.com/watch?v=T6bQsKyAXyM
https://sk.wikipedia.org/wiki/Krvn%C3%BD_obeh
https://biopedia.sk/clovek/srdcovo-cievna-sustava
https://eluc.kr-olomoucky.cz/verejne/lekce/234
https://oskole.detiamy.sk/clanok/nervova-sustava-9595
https://www.youtube.com/watch?v=aAVTG3xkJJU
https://biologia.estranky.sk/clanky/nervova--sustava.html
https://oskole.detiamy.sk/clanok/vyssia-nervova-sustava
https://cs.wikipedia.org/wiki/D%C3%BDchac%C3%AD_soustava_%C4%8Dlov%C4%9Bka
http://www.nabla.cz/obsah/biologie/kapitoly/biologie-cloveka/dychaci-soustava-cloveka.php
https://oskole.detiamy.sk/clanok/dychacia-sustava-9302
https://biopedia.sk/clovek/dychacia-sustava
https://www.youtube.com/watch?v=34iSralulXg
https://cs.wikipedia.org/wiki/Lidsk%C3%A1_v%C3%BD%C5%BEiva
https://www.skolskyportal.sk/skola-stravovanie/pitny-rezim-dolezita-sucast-zdraveho-zivotneho-stylu
https://oskole.detiamy.sk/clanok/potrava-a-jej-zakladne-zlozky/2
https://cs.wikipedia.org/wiki/Imunitn%C3%AD_syst%C3%A9m
https://www.wikiskripta.eu/w/Specifick%C3%A1_imunita
https://www.wikiskripta.eu/w/Nespecifick%C3%A1_imunita
https://www.youtube.com/watch?v=pFe3SSWy9mE
https://biopedia.sk/clovek/imunitny-system
https://oskole.detiamy.sk/clanok/imunitny-system-a-imunita

**Learning unit 1:**

## Circulatory system + Blood types

(basic terms and definitions, the meaning of the circulatory system and its individual parts, body fluids and blood cells, blood circulation, blood groups)

**Teaching hours: 3**

| Content | Performance |
|---|---|
| **Circulatory system - definition.**<br><br>**Main parts of circulatory system.**<br><br>**Circulatory system functions.**<br><br>**Body fluids.**<br><br>**Blood cells.**<br><br>**Division of vessels.**<br><br>**Heart - structure.**<br><br>**Pulmonary and systematic blood circulation.**<br><br>**Blood groups.** | **At the end of the course a student can:**<br>– explain the meaning of the circulatory system<br>– characterize the components of the circulatory system<br>– explain the functions of the circulatory system<br>– describe the function and composition of body fluids<br>– describe the importance and structure of blood cells<br>– characterize the division of blood vessels and describe blood vessels<br>– describe the structure of the heart and its function in the circulatory system<br>– explain the principle of pulmonary circulation<br>– explain the principle of systematic blood circulation<br>– describe the types of blood groups and their significance |

| **Learning unit 2:**<br>**Nervous system**<br>(basic terms and definitions, the importance of the nervous system and its individual parts, spinal cord and brain, nerve cells, transmission of stir, reflex arc) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Nervous system – definition.**<br>**Division of the nervous system.**<br>**Spinal cord and brain.**<br>**Nervous system functions.**<br>**Nerve cells - neurons, their structure and function.**<br>**Stir transmission and reflex arc.** | **At the end of the course a student can:**<br>– characterize the nervous system<br>– describe the division of the nervous system<br>– describe the function and structure of the spinal cord and brain<br>– characterize the functions of the nervous system<br>– describe nerve cells, their function, division and structure<br>– describe the principle of transmission of stir and response to stimuli<br>– explain what a reflex arc is and its function<br>– characterize conditioned and unconditional reflexes |

| **Learning unit 3:**<br>**Respiration system**<br>(basic terms and definitions, the meaning of the respiratory system and its individual parts) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Respiratory system - definition.**<br>**Breathing.**<br>**Upper and lower airways.**<br>**Lung ventilation.**<br>**Defensive respiratory reflexes.** | **At the end of the course a student can:**<br>– characterize the respiratory system and its importance<br>– explain the concept of respiration, describe its mechanism and individual sub-processes<br>– characterize the upper respiratory tract<br>– describe the respiratory tract, nasal cavity and nasopharynx<br>– characterize the lower respiratory tract<br>– describe the larynx, trachea, lungs, bronchi<br>– explain the concept of lung ventilation and characterize the total lung capacity<br>– describe defensive breathing reflexes (sneezing, cough) |

| Learning unit 4:<br>**How can nutrition influence the functioning of organism?**<br>(basic terms and definitions, the importance of individual components of food, the importance of fluid intake) | |
|---|---|
| **Teaching hours: 2** | |
| **Content** | **Performance** |
| **Food evaluation.**<br><br>**Basic food ingredients.**<br><br>**By - ingredients of food.**<br><br>**Drinking regime.** | **At the end of the course a student can:**<br>– explain the evaluation of food in terms of quality and quantity<br>– characterize the basic components of food<br>– describe the function and effects of proteins, fats and sugars<br>– characterize the secondary components of the food<br>– describe the function and effects of water, salts, fiber, vitamins<br>– explain the importance of fluid intake<br>– characterize fluid sources<br>– describe the functions of water in the body |

| **Learning unit 5:**<br>**Defense functions of the organism (How does the immune system work?)**<br>(basic terms and definitions, the importance of the immune system and its individual parts, specific and non-specific immunity) | |
|---|---|
| **Teaching hours: 3** | |
| **Content** | **Performance** |
| **Immune system - definition.**<br><br>**Immunity, antigen, immunology.**<br><br>**Components of the immune system.**<br><br>**Allergy.**<br><br>**Immunization.** | **At the end of the course a student can:**<br>– characterize the immune system and its function<br>– explain the concept of immunity<br>– describe specific and non-specific immunity<br>– explain the concept of antigen<br>– explain the concept of immunology<br>– name and describe parts of the immune system<br>– explain the concept of allergy and immunization |