

# Biology

Grade Span 9/10

## Life Processes of Plants, Fungi and Bacteria

### Selected Functions of Plant Organs

#### *Subject Matter and Methodological Competencies*

- explain structure-function relationships using the example of a leaf
- investigate the cross section of a leaf using a microscope
- explain uptake and transport of water within a plant (diffusion, osmosis, capillary action, transpiration, suction)

### Photosynthesis and Metabolism of Green Plants

#### *Subject Matter and Methodological Competencies*

- describe the metabolism of green plants and its significance for the organism
  - identify the cell as the locus of material and energy transformations
  - explain the importance of carbon dioxide, water, mineral salts and light energy in the synthesis of plant tissue
  - name starting materials, end products and conditions for the process of photosynthesis and respiration and write equations describing these processes
- conduct experiments
  - detection of starch, dextrose, proteins and fats as components of plants
  - detection of carbon dioxide as a reaction product of respiration
- explain the influence of light on photosynthesis and the influence of temperature on respiration; propose and justify possibilities for increasing the yield of plants

### Metabolism of Fungi and Bacteria

#### *Subject Matter and Methodological Competencies*

- describe the metabolism of fungi and bacteria using the examples of alcoholic fermentation and lactic acid fermentation
- explain the possibilities for commercial use of alcoholic fermentation and lactic acid fermentation

## Systematization

### *Subject Matter and Methodological Competencies*

- compare metabolic processes and place them within a system of classification
  - assimilation: autotrophy (photosynthesis) and heterotrophy
  - dissimilation: respiration and fermentation

### *Social and Emotional Competencies*

- agree on, adhere to, and assess compliance with rules of conduct for experiments and microscopy

## Organisms in Their Environments

### *Subject Matter and Methodological Competencies*

- explain the effect of environmental factors on organism, namely
  - explain the ecological tolerance range of living beings and describe organisms' adaptation to their habitat using an example
  - explain the effect of biotic factors on the predator-prey relationship and competition, illustrating each using an example
- characterize ecosystems
  - characterize an ecosystem in terms of biotope and biocenosis, and define the terms ecosystem, biotope and biocenosis
  - explain spatial and temporal structures using an ecosystem as an example (stratification, aspect sequence)
- explain the cycle of matter and energy flow
- explain stability and dynamics as well as impacts on an ecosystem
  - explain possibilities for ecosystem self-regulation using an example
  - justify the importance of structural and species diversity for the stability of an ecosystem
  - compare ecosystems subject to intensive economic use with ecosystems nearer to a natural state
  - evaluate human interventions in nature using an example and explain the principle of sustainability
- in conjunction with an ecological field trip
  - describe the structure of an ecosystem
  - extend and apply knowledge of species

### *Social and Emotional Competencies*

- use one's knowledge of ecology to form a point of view on a given topic and engage objectively with the opinions of others

- substantiate the necessity of scientific expertise in reaching appropriate decisions and taking action regarding
  - conservation of habitats
  - responsible use of natural resources
- agree on and adhere to rules of conduct during excursions and reflect on the behavior of the group
- work cooperatively in groups and take responsibility for the communal work process

## Storage, Transmission, Expression and Modification of Genetic Information

### Storage of Genetic Information

#### *Subject Matter Competencies*

- describe the main features of the cellular, structural and molecular bases of heredity (cell nucleus, chromosomes, genome, DNA and RNA)

### Transfer of Genetic Information

#### *Subject Matter Competencies*

- describe the duplication of DNA using the rule of complementary base pairing as a prerequisite for constancy of genetic information
- explain the transmission of genetic information
  - describe the process of mitosis and the formation of genetically identical cells
  - describe the process of meiosis and explain the development of genetically variable cells
- explain the importance of the transmission of genetic information for cell division and for sexual reproduction
- explain Mendel's First and Second Laws (dominant-recessive, intermediate and codominant heredity)
- explain recombination possibilities

### Expression of Genetic Information

#### *Subject Matter Competencies*

- explain the path from gene to protein using the rule of complementary base pairing
  - coding of proteins by sequences of DNA triplets (codons)
  - transcription
  - translation
- understand the importance of proteins in the expression of characteristics

## **Modification of Genetic Information**

### *Subject Matter Competencies*

- explain mutation, recombination, and modification as causes of variability; characterize modification as a non-hereditary alteration
- explain the importance of variability for living organisms

### *Social and Emotional Competencies*

- discuss the importance of genetic knowledge (e.g. chromosomes as material carriers of genetic information, laws of heredity) for a scientifically based world view
- use one's knowledge of genetics to evaluate the effects of mutagens

## **Applied Genetics**

### **Human Genetics**

#### *Subject Matter Competencies*

- describe causes and symptoms of genetic disorders
  - Trisomy 21 as a spontaneously occurring disorder
  - Hemophilia as a hereditary coagulation disorder
- using one of these examples, explain the possibilities and limits of genetic counseling, diagnosis and therapy with respect to genetic disorders

### **Applications of Genetics in Biotechnology**

#### *Subject Matter Competencies*

- explain the production of genetically modified bacteria (principle of gene transfer) and their use in the manufacture of pharmaceuticals using the example of human insulin
- critically evaluate the use of genetically modified bacteria
- describe basic applications of knowledge about mitosis
  - plant propagation
  - cloning

#### *Social and Emotional Competencies*

- demonstrate respect for people with congenital physical and mental disabilities
- explain the necessity of applying genetic expertise to appropriately evaluate biotechnological applications

## Evolution

### Theories of Evolution

#### *Subject Matter Competencies*

- distinguish scientific views on the origin and development of living beings from the teachings of creationism
- explain the fundamental statements of Charles Darwin on the origin of species and their importance for the development of the scientific theory of evolution
- explain the emergence of new species according to the synthetic theory of evolution (interaction of mutation, recombination, isolation and selection) using an example

### Evidence of Evolution

#### *Subject Matter Competencies*

- explain the importance of fossils, homologies, rudiments and transitional forms as evidence of evolution

### Evolution of Humans from Animal Ancestors

#### *Subject Matter Competencies*

- explain the general principles relevant to the development of humans from animal ancestors (evolutionary family of humanoid apes and humans, Australopithecus, *Homo* genus with the important representatives *H. erectus*, *H. neanderthalensis* and *H. sapiens*)

#### *Social and Emotional Competencies*

- explain the importance of findings in evolutionary biology for a scientifically based world view
- engage objectively with the opinions of others and accommodate diverse views on the origin and development of life