

Biology - Programme subject in programmes for specialization in general studies

Dette er ei omsetjing av den fastsette læreplankoden. Læreplanen er fastsett på Nynorsk

Laid down as a regulation by the Norwegian Directorate for Education and Training on 29 March 2006 as delegated in a letter of 26 September 2005 from the Ministry of Education and Research pursuant to the Act of 17 July 1998 no. 61 relating to primary and secondary education (Education Act) Section 3-4 first paragraph.

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Utdannings-

Purpose

Man has always depended on his knowledge of nature to survive. Biological knowledge includes everything from the amazing world that occurs at micro level in cells to the interaction in the earth's ecosystem. Access to knowledge is growing fast, and biology involves being able to apply specialized knowledge to describe and understand new phenomena, create new areas of learning and participate with professional competence in public debate.

The programme subject shall provide a basis for applying biology studies in various contexts, in practical situations in everyday life and for evaluating broad ethical issues. Through the programme subject *biology*, the pupil shall learn that man is just one of many species, that there is an interplay between man and nature, and that knowledge of biology is an important prerequisite for the sustainable management of natural resources and the environment.

The programme subject shall introduce the pupil to the subject's culture, language and working methods, and provide training in different forms of communication. It shall help teach the pupil to focus on detail and develop a coherent understanding, with emphasis on observation, discussion, critical assessment and requirements for ground rules. The programme subject provides a basis for further studies in biology and related subjects. At the same time, teaching in the subject shall emphasize the general educative aspects of biology studies, such as knowledge linked to environmental challenges, sustainable development, biotechnology issues and questions relating to physiology and health. This competence can provide the basis for acquiring new knowledge throughout life. Since biology is constantly developing, the subject also includes a historical perspective. The programme subject provides a good opportunity for studying variation and deviation from theory and models as a basis for developing new theories and models.

The programme subject shall use nature and the environment as a teaching arena, and thus provide a basis for experiencing the joy and wonder of nature and developing respect for the environment. To develop knowledge about methods and ways of thinking in biology, it is necessary to work both practically and theoretically with the programme subject. The interaction between theoretical knowledge and practical skills and experience from the laboratory and field work is fundamental to understanding biology. Teaching in the subject shall ensure that these perspectives are safeguarded in the work with the programme subject.

Structure

Biology comprises two programme subjects: *Biology 1* and *Biology 2*. The subject is built up in such a way that either programme subject may be selected independently of the other.

These programme subjects have been structured into main subject areas, for which competence aims have been formulated. The main subject areas complement each other, and should be viewed in relation to one another.

Overview of the main subject areas:

Programme subject	Main subject areas					
Biology 1	The Young Biologist	Cell biology	Human physiology	Function and adaptation	Biological diversity	
Biology 2	The Young Biologist	Energy conversion	Genetics	Biotechnology	Ecology	Evolution

Main subject areas

Biology 1

The Young Biologist

The main subject area deals with the use of biology-specific working methods in ecological fieldwork, investigation and laboratory experimentation. The subject area also involves various environmental challenges, and evaluating information in the media. It also covers the ethical aspects of such problems.

Cell biology

The main subject area deals with the complex internal structure of eukaryotic cells, how the various parts function, and transport of material through the cell walls. The subject area also covers the structure and reproduction of bacteria and viruses.

Human physiology

The main subject area deals with different types of tissue, organs and organ systems and how they function. It also deals with the interaction between different processes in the body and the regulation of these processes. The main subject area also covers the body's natural immune system and problems relating to organ donation.

Function and adaptation

The main subject area deals with the development of life on earth and how this has resulted in a diversity of organisms that display various ways of adapting to different living conditions. Selected features from the structure, function, reproduction and behaviour of organisms are seen in relation to this development.

Biological diversity

The main subject area deals with biological diversity, both locally and globally, and how the threat against biodiversity is one of the great challenges facing mankind today. Other elements in this subject area are the classification of species and the degree of variation within and between populations, as well as the relationship between diversity, habitat and niches.

Biology 2

The Young Biologist

The main subject area deals with the use of subject-specific working methods in ecological fieldwork and laboratory experimentation. The subject area also includes working with various environmental challenges, and evaluation of information in the media. It also covers the ethical aspects of such problems.

Energy conversion

The main subject area deals with the fundamental processes and reactions in photosynthesis and cell respiration. It also deals with the role played by enzymes and cofactors in biochemical processes.

Genetics

The main subject area deals with the structure of the DNA molecule and how it contains the genetic instructions used in the development and function of all living organisms. The subject area also deals

with how hereditary patterns can be studied from generation to generation, and how changes in the coding of the DNA molecule can result in mutations and diseases.

Biotechnology

The main subject area deals with the development in biotechnology and gene technology, and how this has resulted in new remedies and techniques in the areas of medicine, food production and biological research. The subject area also deals with ethical and environmental challenges associated with the use of biotechnology.

Ecology

The main subject area deals with the universal interaction between all living organisms, as well as the physical and chemical conditions in which they exist. The subject area also covers criteria that regulate and influence different populations in an ecosystem. Man-made environmental problems also form part of this subject area.

Evolution

The main subject area deals with how life on earth might have started and how life forms have developed along the way. Central to this programme area is the origin of new species with new characteristics seen in relation to the fundamental mechanisms that can change the genetic composition in populations.

Teaching hours

Teaching hours are given in 60-minute units.

Biology 1: 140 teaching hours per year

Biology 2: 140 teaching hours per year

Basic skills

Basic skills are integrated into the competence aims for this course in areas where they contribute to the development of and are part of the subject competence. In the Biology programme subject, basic skills are understood as follows:

Being able to express oneself orally and in writing in Biology involves accounting for one's own observations and indications from nature and the laboratory by applying subject-specific concepts. It includes being able to formulate questions and hypotheses that can be investigated, reasoned and discussed in relation to other biological information. It also involves being able to critically assess various types of biological information in professional journals and the media.

Being able to read in Biology involves the ability to gather, interpret and reflect on the information found in newspapers, periodicals, books and brochures and on the Internet. It involves being able to understand formulae, tables, diagrams and symbols. It also means studying new areas of the subject by understanding more advanced biological literature.

Numeracy in Biology involves the ability to use numbers and mathematical computations, take readings and carry out simple statistical analyses, and work with and present the results of one's own observations. It also means being able to understand and apply mathematical models from biological research. Similarly, it involves understanding results in the form of graphs and tables.

Being able to use digital tools in Biology means gathering information and research, taking readings, and working with and presenting the results of one's own observations. It covers the use of animations and simulations to illustrate and explain scientific material. It also involves evaluating scientific information found on the Internet.

Competence aims

Biology 1

The Young Biologist

The aims of the studies are to enable pupils to

- plan and implement tests in the laboratory from all the main areas, report on the work with and without digital tools, and point out sources of error in the tests
- carry out a major field study and use scientific methods to gather, chart and research different types of organisms, as well as present the results from the study
- observe and identify species from various biotopes and compare these with respect to common features and variation by using biological systematics
- extract information from biological reports, brochures, newspapers, books and the Internet, and analyze how the information is supported

Cell biology

The aims of the studies are to enable pupils to

- give an account of the structure of eukaryotic cells and explain the functions of the various parts of the cells
- explain transport between the cell membrane based on an understanding of passive and active transport mechanisms
- give an account of the structure and reproduction of bacteria and viruses, and relate this to processes in nature, industry and healthcare

Human physiology

The aims of the studies are to enable pupils to

- give an account of the structure and function of the central organ system in the body, and discuss causes of diseases associated with lifestyle
- compare the hormonal and nervous systems and explain how these systems are affected by various substances
- give an account of the immune system and other elements of the body's defence mechanism against infection
- discuss problems associated with organ donations and medical criteria for death

Function and adaptation

The aims of the studies are to enable pupils to

- compare the structure and function of organs in various animal groups, with emphasis on circulation, gaseous exchange and secretion, in the context of adapting to different environments and conditions
- give an account of the main features in the reproduction of plants and animals in the context of the development of life on earth

- explain how plants absorb and transport water and solutions, and discuss how plants can adapt to different environments and conditions
- discuss how external factors affect the growth and development of plants
- explain and substantiate how behaviour as a result of evolution is part of the adaptation to the surroundings

Biological diversity

The aims of the studies are to enable pupils to

- explain what the term biological diversity covers, and discuss issues concerning the responsibility for safeguarding biological diversity locally and globally
- explain how a species is defined and how biological diversity is organized in a taxonomical system
- give an account of variation within and between populations of the same species, and explain what this variation means
- explain how biological diversity is linked with variation in habitat and niches in the ecosystem

Biology 2

The Young Biologist

The aims of the studies are to enable pupils to

- plan and implement tests in the laboratory from all the main areas, report on the work with and without digital tools, and point out sources of errors in the tests
- plan and implement a major field study with an examination of biotic and abiotic factors in an ecosystem, and evaluate and present the results with and without digital tools
- explain why publishing and professional criticism are necessary processes in biology as a science
- find new areas of study in biology from various media and evaluate information and media claims from a scientific point of view
- discuss on a professional basis ethical challenges within biological research
- discuss environmental challenges locally and globally based on biological knowledge
- use animation and simulation software to show phenomena and biological connections

Energy conversion

The aims of the studies are to enable pupils to

- compare the main features and energy exchange in aerobic and anaerobic degradation of glucose, and link the energy conversion in cells to the composition of nutrients in food
- explain how enzymes, ATP and other cofactors work, and how enzyme activity is regulated in cells and tissue
- explain how light energy is converted to chemically bound energy in photosynthesis, and how this energy is used to produce glucose
- give an account of how external factors affect photosynthesis

Genetics

The aims of the studies are to enable pupils to

- explain the structure of DNA and how DNA is replicated before the cells divide
- give an account of the transcription and translation of genes and explain how the regulation of a gene can control biological processes
- compare mitosis and meiosis with emphasis on the distribution of genetic material in the cells formed through duplication

- set up and test hypotheses for gender determination and dihybrid inheritance with and without a coupling of genes
- explain genetic diseases by using studies of heredity and mutations, and give an account of how the interaction between heredity, environment and lifestyle can affect the health of humans

Biotechnology

The aims of the studies are to enable pupils to

- give an account of genetic fingerprinting and how the technique can be used in forensic science and in the study of relationships between individuals and groups of organisms
- explain how genetically modified organisms can be produced; discuss how this can be used in medicine, food production and biological research, and what impact it can have on the environment
- give an account of the biological value of stem cells, explain the principle for reproductive and therapeutic cloning, and discuss ethical aspects associated with the selection of different sources of stem cells
- formulate and discuss problems involving the use of genetic diagnosis and genetic therapy on humans

Ecology

The aims of the studies are to enable pupils to

- collect, define and classify different organisms and link information about mode of living and adaptations to a selection of organisms
- give an account of factors that regulate growth and size of populations and management of stocks in a sustainable perspective
- give an account of the carbon and nitrogen cycles in an ecosystem, and how environmental poisons are concentrated in food chains
- give an account of how the energy flow between trophic levels affects the ecosystem
- explain how an ecosystem can change over time, and link it to climate change and other environmental problems

Evolution

The aims of the studies are to enable pupils to

- give an account of the main features of the theory of evolution and the kind of studies it is based on
- give an account of theories of the origin of species, and describe some of the main features of how life on earth has developed
- explain how the genetic composition in populations is changed by mutations, natural selection, genetic drift, gene flow, horizontal gene transfer and change in the number of chromosomes
- describe mechanisms that prevent gene flow between species, and give an account of theories about how new species can develop
- explain how molecular biology and gene technology have provided us with new ideas about the origin of species and development of the evolutionary tree

Assessment

Provisions for final assessment:

Overall achievement grades

Programme subject	Provision
Biology 1	The pupils shall have an overall achievement mark.
Biology 2	The pupils shall have an overall achievement mark.

Examination for pupils

Programme subject	Provision
Biology 1	The pupils may be selected for an oral-practical exam. The oral-practical exam is prepared and marked locally.
Biology 2	The pupils may be selected for a written or oral-practical exam. The written exam is prepared and marked centrally. The oral-practical exam is prepared and marked locally.

Examination for external candidates

Programme subject	Provision
Biology 1	The external candidates shall sit for an oral-practical exam. The exam is prepared and marked locally.
Biology 2	The external candidates shall sit for a written exam and oral-practical exam. The written exam is prepared and marked centrally. The oral-practical exam is prepared and marked locally.

The provisions for assessment are stipulated in the regulations of the Norwegian Education Act.