

Natural science subject curriculum

Dette er en oversettelse av den fastsatte læreplanteksten. Læreplanen er fastsatt på Bokmål

Established as a Regulation by the Ministry of Education and Research on 24 June 2010

Valid from 01.08.2010

Valid to 31.07.2013



Purpose

Natural science is the result of human curiosity and our need to find answers to questions about our existence, life and life forms, and our place in nature and the universe, and in this way it becomes part of our culture.

The laws and theories of natural science are models of a complex reality, and these models are changed or developed through new observations, experiments and ideas. In our general knowledge it is important to realise that natural science is developing, and that research and new knowledge in natural science and technology have great importance for societal development and the environment in which we live.

Even though natural science is divided into disciplines such as biology, physics, chemistry and geo-subjects, the aim is that natural science shall appear as a holistic school subject, both theoretically and practically.

Knowledge on, understanding of and experiences in nature can strengthen the will to protect natural resources, preserve biological diversity and contribute to sustainable development. In this context Sami and other indigenous peoples have knowledge of nature that it is important to respect. Natural science shall also help children and young persons attain knowledge and form attitudes that will give them a considered view of the interaction between nature, individuals, technology, society and research. This is important for the possibilities the individual has to understand various types of natural science and technological information and shall give one the basis for participation in democratic processes in society.

Practical and theoretical work in laboratories and in the field using different theses and research questions is necessary to gain experience with and develop knowledge of the methods and approaches in natural science. This may contribute to developing creativity, the critical eye, openness and active participation in situations involving natural science knowledge and expertise. Varied learning environments such as fieldwork in nature, experiments in the laboratory and excursions to museums, science centres and business enterprises/industries will enhance the teaching in natural science and impart a sense of wonder, inquisitiveness and fascination. Competence in understanding different types of natural science texts, methods and technological solutions gives a good basis for vocational training, further studies and lifelong learning, both at work and in one's leisure time

Main subject areas

The subject has been structured into main areas for which competence aims have been formulated. These main subject areas supplement each other and must be considered together.

This subject is a common core subject for all the upper secondary education programmes. Learning in this subject shall therefore be made as relevant as possible for pupils by adapting each subject to its education programme as much as possible.

Natural science has competence aims after the second, fourth, seventh and tenth years in primary and lower secondary education, after Vg1 (the first year) in programmes for general studies and vocational education programmes in upper secondary education, and after Vg3 supplementary studies qualifying for higher education.

Overview of main subject areas:

| Year | Main subject areas |
|------|--------------------|
|------|--------------------|

| | | | | | | |
|---|------------------------|-------------------------|----------------------|------------------------------|-----------------------------------|-----------------------|
| 1-10 | The budding researcher | Diversity in nature | Body and health | The universe | Phenomena and substances/elements | Technology and design |
| Vg1 programmes for general studies | The budding researcher | Sustainable development | Nutrition and health | Radiation and radio-activity | Energy for the future | Bio-technology |
| Vg1 vocational education programmes | The budding researcher | Sustainable development | Nutrition and health | | Energy for the future | |
| Vg3 supplementary studies qualifying for higher education | The budding researcher | Sustainable development | | Radiation and radio-activity | Energy for the future | Bio-technology |

The budding researcher

There are two sides to the teaching of natural science: it is a product showing the knowledge we currently have, and it is a process consisting of natural science methodologies for developing knowledge. This involves the formulation of hypotheses, experimentation, systematic observations, openness, discussions, critical assessment, argumentation, grounds for conclusion and presentation. *The budding researcher* shall work with these dimensions of education.

Diversity in nature

A central element of this main subject area is development of knowledge on and respect for the diversity of nature. To discuss this diversity it is necessary to know the names of some species of plants and animals and of the elements that are part of the interplay in an ecosystem. This main subject area also focuses on the requirements for sustainable development, the place of man in nature, and how human activities have changed and continue to change the natural environment locally and globally. Fieldwork ensures a good basis for knowledge on and attitudes in this area.

In Vg1 this main subject area is called *sustainable development*, which expresses its focus.

Body and health

The main subject area *Body and health* focuses on the structure of our bodies and how the body is affected and changed over time. Respect and care for others are also key elements in this area. Body, health, lifestyle and nutrition are frequently mentioned in the media. Knowledge and critical assessment of information in this area are important to enable pupils to assume responsibility for their body and physical and mental health.

In Vg1 this main subject area is called *body and health*, which expresses its focus.

The universe

This main subject area focuses on our own solar system, the location of the earth and outer space. Research and technological innovations are giving us more and more knowledge about the universe. The media frequently provide information about this knowledge. The topic lends itself to discussing perspectives on the future and thus opens for curiosity, a sense of wonder and fascination.

In Vg1 this main subject area is called *radiation and radioactivity*, which expresses its focus.

Phenomena and substances/elements

This main subject area focuses on key areas from physics and chemistry, and deals with the structure of substances, how substances react with each other and important phenomena such as sound, light, electricity and magnetism, energy and energy sources.

This area also focuses on the relationship between phenomena, and how mankind has learned to exploit various phenomena and substances.

In Vg1 this main subject area is called *energy for the future*, which expresses its focus.

Technology and design

The main subject area *technology and design* covers several subjects, including natural science, mathematics and arts and crafts. Technology and design focuses on planning, developing and making products that are useful in our day-to-day lives. The interaction between natural science and technology is a key part of this main subject area. Natural science principles constitute the basis for understanding technological activities.

In Vg1 this main subject area is called *biotechnology*, which expresses its focus.

Teaching hours

Teaching hours are given in 60-minute units:

PRIMARY EDUCATION

Years 1 to 7: 328 teaching hours

LOWER SECONDARY EDUCATION

Years 8 to 10: 256 teaching hours

PROGRAMMES FOR GENERAL STUDIES

Vg1: 140 teaching hours

VOCATIONAL EDUCATION PROGRAMMES

Vg1: 56 teaching hours

SUPPLEMENTARY STUDIES QUALIFYING FOR HIGHER EDUCATION

Vg3: 84 teaching hours

Basic skills

Basic skills are integrated in the competence aims where they contribute to development of the competence in the subject, while also being part of this competence. In the natural science subject the basic skills are understood as follows:

Being able to express oneself orally and in writing in the natural science subject means presenting and describing one's own experiences and observations from nature. In the natural science subject, written reports from experiments, fieldwork, excursions and technological development processes are an important part of the work. This includes the ability to formulate questions and hypotheses and to use natural science terms and concepts. Arguing for one's own assessments and giving constructive feedback is important in the natural science subject.

Being able to read in the natural science subject means collecting information, interpreting and reflecting on the content of natural science texts, brochures, newspapers, books and information on the internet. Reading in the natural science subject also includes reading manuals, recipes, tables, various graphs and symbols.

Numeracy in the natural science subject means using numbers and calculations to register and calculate results from one's own measurements and to prepare tables and graphs with natural science content. Being able to do mathematics also means using and interpreting formulas and models from the real world and processing and interpreting various types of data.

Being able to use digital tools in the natural science subject means being able to use such tools for exploration, measurement, visualisation, simulation, registration, documentation and publication when performing experiments and fieldwork. Digital animations, simulations and games are good aids for stimulating creativity, and demonstrating and visualising natural science problems and research questions. Critical assessment of internet-based information reinforces the work in this subject. Digital communication systems make it possible to discuss natural science problems and research questions.

Competence aims

Competence aims after Year 2

The budding researcher

The aims of the studies are to enable pupils to

- ask questions, talk and philosophise about experiences in nature and man's place in nature
- use one's senses to explore the world in the local neighbourhood
- describe his or her own observations from experiments and in nature

Diversity in nature

The aims of the studies are to enable pupils to

- recognise and describe some plant and animal species and sort them
- describe some important characteristics of the four seasons by observing nature
- participate in various activities in nature and tell others about what has been observed

Body and health

The aims of the studies are to enable pupils to

- name and describe the function of some external and internal body parts

- describe and talk about our senses and use them deliberately during indoor and outdoor activities

The universe

The aims of the studies are to enable pupils to

- describe how the earth, moon and sun move in relation to each other
- observe and describe the seasons, day and night and different phases of the moon, and explain how Sami culture divides the year

Phenomena and substances/elements

The aims of the studies are to enable pupils to

- sort various substances according to easily observable characteristics and tell others about these characteristics
- perform experiments with water and light and discuss the observations

Technology and design

The aims of the studies are to enable pupils to

- make artefacts that are able to be propelled by water or air and tell others about what they have made
- make artefacts that use reflection of light and tell others about what they have made

Competence aims after Year 4

The budding researcher

The aims of the studies are to enable pupils to

- use natural science terms to describe and present his or her own observations in various ways
- collect and systematise data and present the results with and without digital aids
- use simple measuring instruments for examinations

Diversity in nature

The aims of the studies are to enable pupils to

- talk about the lifecycle of some plant and animal species
- observe and note what happens with a tree or another perennial plant over time
- collect and systematise information and describe some extinct animal species and groups of animals and how they lived
- tell others about animals and discuss what is good animal welfare
- argue for appropriate behaviour in nature

Body and health

The aims of the studies are to enable pupils to

- talk about the development of the human body from conception to adulthood

- describe in general terms the structure of the human body, and the functions of some internal organs
- describe some common childhood diseases and what inoculation is
- observe and describe how the human body reacts in a number of situations
- discuss various emotional experiences and reactions and the relationship between physical and mental health

The universe

The aims of the studies are to enable pupils to

- find information with and without digital tools and tell others about some of the planets in our solar system
- recognise some constellations and describe phenomena that can be observed in the sky
- talk about myths and legends in connection with the sky and northern lights in Norwegian and Sami tradition

Phenomena and substances/elements

The aims of the studies are to enable pupils to

- describe how and discuss and elaborate on why we sort waste at the source
- give examples of a lifecycle loop in nature based on biological degradation
- carry out experiments showing that substances may change their nature when subjected to various influences
- make experiments with air and sound and describe the observations
- describe his or her own observations of weather and clouds and measure temperatures and precipitation

Technology and design

The aims of the studies are to enable pupils to

- plan, build and test simple models of building constructions and document the process from idea to complete product
- describe constructions and discuss why some are more stable and withstand greater loads than others
- recognise and compare load-carrying structures in various buildings in the local neighbourhood

Competence aims after Year 7

The budding researcher

The aims of the studies are to enable pupils to

- formulate questions on something he or she is curious about, prepare a plan for examining a hypothesis he or she has formulated, carry out the examination and discuss the result
- explain why it is important to make and test hypotheses through systematic observations and experiments, and why it is important to compare results
- use digital aids and natural science equipment for experimental work and fieldwork
- extract natural science information from simple natural science texts in different media
- publish results from his or her own examinations using digital tools

Diversity in nature

The aims of the studies are to enable pupils to

- plan and carry out studies in some nature areas in cooperation with others
- examine and describe flowers and plants and explain the functions of the different plant parts
- describe characteristics of vertebrates and explain the functions of the most important organs
- examine and describe factors that influence the germination and growth of plants
- describe the characteristics of a selection of plant, mushroom and animal species and tell others how these are ordered systematically
- tell others about the use of some plant, mushroom and animal species according to some traditions, including Sami traditions

Body and health

The aims of the studies are to enable pupils to

- describe the most important organs in the human body and their functions
- describe the human skeleton and muscles and elaborate on how the body can move
- explain what happens during puberty and talk about gender identities and variation in sexual orientation
- collect information about and discuss dangers to one's health that can result from substance abuse

The universe

The aims of the studies are to enable pupils to

- describe our solar system and natural science theories on the origin of the earth
- describe a model of the solar system and how this model may explain observed phenomena, including night and day, phases of the moon and the sun travelling across the sky

Phenomena and substances/elements

The aims of the studies are to enable pupils to

- examine and describe some central characteristics of some minerals and rocks and how they have been formed
- carry out experiments with sound, hearing and noise, describe and explain the results and how we may protect ourselves from unwanted sounds
- carry out experiments with magnetism and electricity, describe and explain the results
- elaborate on the use of some sources of energy in earlier times and in contemporary times, and describe consequences for the environment, locally and globally
- carry out relevant weather measurements and present the results with and without digital aids
- describe central characteristics of gases, liquids, solids and phase transitions using the particle model
- explain the structure of substances and how substances may be transformed, by using the concepts of atoms and molecules
- carry out experiments with chemical reactions and explain what characterises these reactions

Technology and design

The aims of the studies are to enable pupils to

- plan, build and test mechanical toys, describe various movements of the toys and the principles of mechanical transfer
- plan, build and test simple products that use electrical energy, explain how they work and describe the process from idea to finished product
- elaborate on how transfer of movement has been used throughout history to exploit the energy potential in wind and water

Competence aims after Year 10

The budding researcher

The aims of the studies are to enable pupils to

- plan and carry out experiments to test the validity of his or her own hypotheses and choose the publication method
- keep records during experiments and fieldwork and present reports using digital aids
- explain the importance of looking for relationships between cause and effect and explain why argumentation, disagreement and publication are important in natural science
- demonstrate protective and safety equipment and comply with fundamental safety procedures in natural science classes

Diversity in nature

The aims of the studies are to enable pupils to

- describe the structure of animal and plant cells and explain the main characteristics of photosynthesis and cellular respiration
- elaborate on cell division and genetic variation and heritage
- explain the main characteristics of evolutionary theory and the underpinning of this theory
- explain the main characteristics of theories on how the earth is changing and has changed throughout all time and the underpinning of these theories
- elaborate on which biotic and abiotic factors are part of an ecosystem and explain the relationship between the factors
- observe and provide examples of how human activities have affected a nature area, identify the views of different interest groups on the effects and propose measures that might preserve nature for future generations
- give examples of how Sami people exploit resources in nature

Body and health

The aims of the studies are to enable pupils to

- discuss elaborate on problems and issues in connection with sexuality, different sexual orientation, contraception, abortion and sexually transmittable diseases
- explain how the human body protects itself against disease
- describe how to prevent and treat infectious diseases
- describe how hormones control different body processes
- explain how the nervous system and the hormone system control body processes
- describe the development of a foetus and how birth occurs
- elaborate on how lifestyles may lead to disease and injury and how this may be prevented

- provide examples of popular medicine, including Sami popular medicine, and discuss the difference between complementary medicine and academic medicine
- elaborate on how the use of intoxicant substances may lead to health damage and discuss how individuals and society may prevent health damage

The universe

The aims of the studies are to enable pupils to

- describe the universe and different theories of how it has developed
- provide an overview of technological equipment used for the exploration of space
- present the main features of the history of space travel and talk about research that determines the possibility of life on other planets
- describe the apparent motion of the planets across the sky using animations and explain how solar and lunar eclipses and seasons come about

Phenomena and substances/elements

The aims of the studies are to enable pupils to

- assess characteristics of elements and compounds using the periodic table
- carry out experiments to classify acidic and alkaline substances
- examine the chemical properties of some common everyday substances
- plan and carry out experiments with detection reactions, separation of substances in a mixture and analysis of an unknown substance
- carry out experiments with and describe hydrocarbons, alcohols and carboxylic acid and some common carbohydrates
- explain how crude oil and natural gas have come about and how these substances are used
- explain results from experiments with electrical circuits using terms such as current, voltage, resistance, output and induction
- explain how we can produce electrical power from renewable and non-renewable sources of energy
- elaborate on the concepts of velocity and acceleration, measure magnitudes using simple aids and give examples of how power is connected to acceleration
- carry out experiments and simple calculations with work, energy and output
- elaborate on how traffic safety equipment prevents and reduces injuries in accidents
- carry out experiments with light, vision and colour, describe and explain the results

Technology and design

The aims of the studies are to enable pupils to

- develop products based on specifications that use electronics, evaluate the design process and assess product functionality and user friendliness
- test and describe characteristics of materials used in a production process
- elaborate on electronic communication systems on the system level and discuss and elaborate on societal challenges in connection with using these

Competence aims after Vg1 – programmes for general studies

The budding researcher

The aims of the studies are to enable pupils to

- plan and carry out different types of investigations in cooperation with others where you identify variables, estimate uncertainties of measurements and assess possible sources of errors
- carry out and interpret animations og simple computer simulations to illustrate natural phenomena and test hypotheses
- explain and assess what can be done to reduce uncertainties of measurements and avoid any possible source errors from measurements and results
- assess the quality of presentations of own and others observation data and interpretations

Sustainable development

The aims of the studies are to enable pupils to

- describe succession processes in an ecosystem
- examine an ecosystem and assess where it is in the succession process
- elaborate on factors that influence the size of a population
- explain what is meant by the "look-before-you-leap" principle, uncertain knowledge and the concept of sustainable development, and give examples of these
- assess important environmental aspects of consumer choices, handling waste and using energy
- select and describe some global conflicts of interest and assess the consequences these might have for the local population and the global community
- elaborate on how the international community is working on global environmental challenges
- provide examples of nature management and changes of natural environments that may have consequences for indigenous peoples in Norway and other countries

Nutrition and health

The aims of the studies are to enable pupils to

- describe chemical characteristics and differences of the most important nutrition substances
- elaborate on the most important trace elements, minerals and salts in the human body
- carry out simple chemical detection of nutrients in food
- explain the main characteristics of digestion, transport and transformation of the most important nutrients
- elaborate on some main components in cosmetic products and make such a product with its own content declaration
- discuss and elaborate on issues in connection with nutrition, exercise, dieting, eating disorders, lifestyle diseases and sunbathing

Radiation and radioactivity

The aims of the studies are to enable pupils to

- describe how the northern lights arise, and how Norway has been and is an important country for research in this field
- explain the importance of the ozone layer with respect to solar irradiation of the earth
- explain what the greenhouse effect is and elaborate on and analyse how human activities are altering the energy balance of the atmosphere
- elaborate on some possible consequences of the increased greenhouse effect, including in Arctic areas, and the measures that are being initiated internationally to reduce the increase in the greenhouse effect
- carry out experiments with radioactivity, half-life and background radiation and explain these phenomena

- describe characteristics of different types of ionising radiation and explain how these are used for technical and medical applications
- explain how electromagnetic radiation from space may be interpreted and provide information about outer space

Energy for the future

The aims of the studies are to enable pupils to

- carry out experiments with solar cells and sun traps and explain the main principles for how these function
- explain how heat pumps function, and in which contexts heat pumps are used
- explain what redox reactions are, carry out experiments with combustion, galvanic elements and electrolysis and elaborate on the results
- describe the principles and areas of use of some common rechargeable and non-rechargeable batteries and fuel cells
- elaborate on different uses of biomass as an energy source
- elaborate on hydrogen as an energy carrier

Biotechnology

The aims of the studies are to enable pupils to

- explain genetic coding and the main characteristics of protein synthesis and discuss the importance of heritage and the environment
- explain the concepts of cross-breeding and gene modification and how biotechnology is used for breeding plants and animals
- provide an overview of different types of medical applications of biotechnology
- assess information about and elaborate on ethical issues in connection with biotechnology

Competence aims after Vg1 - vocational education programmes

The budding researcher

The aims of the studies are to enable pupils to

- plan and carry out different types of investigations in cooperation with others where you identify variables, estimate uncertainties of measurements and assess possible sources of errors
- explain and assess what can be done to reduce uncertainties of measurements and avoid any possible source errors from measurements and results

Sustainable development

The aims of the studies are to enable pupils to

- explain what is meant by the "look-before-you-leap" principle, uncertain knowledge and the concept of sustainable development, and give examples of these
- assess important environmental aspects of consumer choices, handling waste and using energy
- select and describe some global conflicts of interest and assess the consequences these might have for the local population and the global community
- elaborate on how the international community is working on global environmental challenges

- provide examples of nature management and changes of natural environments that may have consequences for indigenous peoples in Norway and other countries

Nutrition and health

The aims of the studies are to enable pupils to

- describe chemical characteristics and differences of the most important nutrition substances
- elaborate on the most important trace elements, minerals and salts in the human body
- carry out simple chemical detection of nutrients in food
- explain the main characteristics of digestion, transport and transformation of the most important nutrients
- elaborate on some main components in cosmetic products and make such a product with its own content declaration
- discuss and elaborate on issues in connection with nutrition, exercise, dieting, eating disorders, lifestyle diseases and sunbathing

Energy for the future

The aims of the studies are to enable pupils to

- carry out experiments with solar cells and sun traps and explain the main principles for how these function
- explain how heat pumps function, and in which contexts heat pumps are used
- elaborate on different uses of biomass as an energy source

Competence aims after Vg3 - supplementary studies qualifying for higher education

The budding researcher

The aims of the studies are to enable pupils to

- carry out and interpret animations og simple computer simulations to illustrate natural phenomena and test hypotheses
- assess the quality of presentations of own and others observation data and interpretations

Sustainable development

The aims of the studies are to enable pupils to

- describe succession processes in an ecosystem
- examine an ecosystem and assess where it is in the succession process
- elaborate on factors that influence the size of a population

Radiation and radioactivity

The aims of the studies are to enable pupils to

- describe how the northern lights arise, and how Norway has been and is an important country for research in this field
- explain the importance of the ozone layer with respect to solar irradiation of the earth

- explain what the greenhouse effect is and elaborate on and analyse how human activities are altering the energy balance of the atmosphere
- elaborate on some possible consequences of the increased greenhouse effect, including in Arctic areas, and the measures that are being initiated internationally to reduce the increase in the greenhouse effect
- carry out experiments with radioactivity, half-life and background radiation and explain these phenomena
- describe characteristics of different types of ionising radiation and explain how these are used for technical and medical applications
- explain how electromagnetic radiation from space may be interpreted and provide information about outer space

Energy for the future

The aims of the studies are to enable pupils to

- explain what redox reactions are, carry out experiments with combustion, galvanic elements and electrolysis and elaborate on the results
- describe the principles and areas of use of some common rechargeable and non-rechargeable batteries and fuel cells
- elaborate on hydrogen as an energy carrier

Biotechnology

The aims of the studies are to enable pupils to

- explain genetic coding and the main characteristics of protein synthesis and discuss the importance of heritage and the environment
- explain the concepts of cross-breeding and gene modification and how biotechnology is used for breeding plants and animals
- provide an overview of different types of medical applications of biotechnology
- assess information about and elaborate on ethical issues in connection with biotechnology

Assessment

Provisions for final assessment:

Overall achievement grades

| Year | Provision |
|--|--|
| Year 10 | The pupils shall have one overall achievement grade. |
| Vg1 vocational education programmes Vg1 programmes for general studies Supplementary studies qualifying for higher education | The pupils shall have one overall achievement grade. |

Examinations for pupils

| Year | Provision |
|--------------------------|--|
| Year 10 | The pupils may be selected for an oral examination with practical elements. The oral examination is prepared and graded locally. |
| Vg1 vocational education | The pupils may be selected for an oral examination with practical |

| | |
|---|--|
| programmes Vg1 programmes for general studies | elements. The oral examination is prepared and graded locally. |
| Supplementary studies qualifying for higher education | The pupils may be selected for an oral examination with practical elements. The oral examination is prepared and graded locally. The examination only includes the subject as it is given in the supplementary studies qualifying for higher education (84 teaching periods). |

Examinations for external candidates

| Year | Provision |
|---|--|
| Year 10 | See the provision in force for primary school education for adults. |
| Vg1 vocational education programmes | External candidates shall sit for an oral examination with practical elements. The oral examination is prepared and graded locally. |
| Vg1 programmes for general studies | External candidates shall sit for an examination which comprises a written paper and an oral examination with practical elements. The written paper is prepared and graded centrally. The oral examination is prepared locally. The grade is set locally. |
| Supplementary studies qualifying for higher education | External candidates shall sit for an oral examination with practical elements. The oral examination is prepared and graded locally. The examination only includes the subject in the supplementary year qualifying candidates for higher education (84 teaching periods). |

The general provisions on assessment have been laid down in the Regulations relating to the Norwegian Education Act.