Appendix 4
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of the Republic of 6 January 2011
National Curriculum for Basic Schools

Last amendment 29 August 2014

Subject Field: Natural Science

1. General Principles

1.1. Competence in Natural Science

The gaining of competencies in natural science refers to the capability to: observe and explain phenomena and processes that exist in the natural, technological and social environment (hereafter referred to as 'the environment'); analyse the environment as a system; identify science-related problems occurring in the environment and use natural science methods to solve them; make decisions on socio-scientific issues. Gaining competencies in natural science also refers to developing an interest in natural science and cultural phenomena as the basis of developing a world view and to value the natural diversity and the need to appreciate a responsible and sustainable lifestyle.

In developing these competencies basic school graduates will be expected to possess the capability to be able to:

1) show interest in the environment, undertake studies on the environment and in the field of natural science and technology, and be motivated for lifelong learning;
2) apply the science knowledge and skills through observing, analysing and explaining the natural science phenomena and processes in the environment, find links between them and draw generalising conclusions
3) identify, formulate and solve natural science related problems, using appropriate scientific methods, and having the ability to present conclusions reached both orally and in writing;
4) make competent decisions in everyday life related to the natural and technological environment, taking into account scientific, economic, political, ethical and moral viewpoints and estimate the impact of such decisions;
5) use different information sources (including electronic) to obtain natural science- and technology-related information, analyse and evaluate the validity of the information contained;
6) acquire through a systemic overview of the main processes taking place in the natural environment, an understanding of the development of the natural sciences as a process that creates new knowledge and provides explanations about the surroundings which have practical outcomes;
7) understand the relationships and differences between different fields in the Natural Science domain, acquire an overview of career opportunities in these fields and apply the knowledge and skills gained when determining a career; and
8) value the environment as a whole; undertake a responsible and sustainable lifestyle connected to the environment and follow a healthy way of life.

1.2. Subjects and Volume of the Subject Field

The following subjects comprise the natural science domain: Science, Biology, Geography, Physics and Chemistry.

Science is studied from the 1st grade to 7st grade s; Biology and Geography from the 7th grade; and Physics and Chemistry from the 8th grade.

The number of hours per week, per subject in the Nature Science domain, by stage of study is as follows:
1st stage of study
Science – 3 hours
2nd stage of study
Science – 7 hours
3rd stage of study
Science – 2 hours per week in the 7th grade
Biology – 5 hours
Geography – 5 hours
Physics – 4 hours
Chemistry – 4 hours
The distribution of weekly hours of subjects within stages of study is specified in the school curriculum considering that the expected learning outcomes and learning and educational objectives would be achieved.

1.3. Description of the Subject Field and Integration within the Subject Field

The subjects in the natural science domain are designed to enhance scientific and technological literacy. In so doing these subjects promote the study of the properties and effects of biological, geographical, chemical, physical and technological phenomena and processes in the environment, as well as the connections between them. The teaching approach, advocated in this domain, and the student-centred study processes connected to it are based on social constructivism, which means that by being involved in solving scientific problems related to environmental issues the students acquire an overview of natural science facts and theories, as well as professions connected to them. Active creative work in the field of natural sciences develops the natural science world view of basic school pupils and helps them make career choices.

It is important for studies in this domain to motivate students and develop their interest in nature, through the identification of environmental problems and the determining of ways to solve them. Studies focus on solving scientific problems using appropriate scientific methods, which involve observation of phenomena and processes, determination of the problems, collection and evaluation of background information, formulation of scientific questions and hypotheses, planning of problem solving experiments carrying them out using appropriate observation and recording of data, analysing and drawing conclusions from the data obtained and presenting summaries orally and in writing. This requires the acquisition of scientific skills and the development of higher levels of thinking.

Integration of subjects within the domain is intended to shape the students' understanding of nature as a whole, including connections and causal effects.

The study of **Science** forms the basis for students' studies in the other natural science subjects (Biology, Physics, Geography and Chemistry) and provides an introduction to a scientific way of thinking. The students learn to identify and purposefully observe the animate and inanimate objects and phenomena of nature, gather and analyse data and draw conclusions on the basis of this data. Through practical activities,

the students learn to find different solutions to problems and through decision making involving society-based perspectives, analyse their possible consequences.

The study of **Biology** as a natural science subject allows students to gain an understanding of phenomena and processes of nature and the connections between living and non-living natural.

The study of **Geography** shape the students' understanding of spatial distribution and mutual connections of phenomena and processes taking place in nature and the society.

Studying the **Physics** students acquire an understanding of physical processes and the possibilities of applying laws of physics to the development of technology and biological functions.

Through studies in the subject of **Chemistry** students acquire knowledge about structure and properties of substances and chemical phenomena, as well as an ability to understand patterns within chemical processes that take place in nature and human activity.

Choices about discussing the learning contents are made by the subject teacher, considering that the learning outcomes, general competencies, subject field and subject competencies described by stages of study would be achieved.

1.4. Options of Forming General Competencies

Through the study of science subjects students are guided to acquire an overview of connections and mutual interactions present in the natural environment, as well as the effect of human activity on the environment. All general competencies described in the general part of the national curriculum are developed by teaching natural sciences. In developing the four interrelated components differentiated in competences - knowledge, skills, values and behaviour - the teacher holds the central role as his/her values and ability to establish himself/herself create a suitable learning environment and affect the values and behaviour of students.

Cultural and value competence. A positive attitude towards all living things and the environment is established, interest towards natural sciences as a cultural phenomenon providing new knowledge and solutions is created, the importance of natural diversity and the need to protect it acknowledged, sustainable and responsible way of live valued and healthful lifestyles formed.

Social and citizenship competence. Students learn to evaluate the impact of human activities to the natural environment, acknowledge local and global environmental issues and find solutions for them. Importance is given to solving dilemma problems, where decisions have to be made considering science perspectives as well as aspects related to human society – legislative, economical and ethical and moral perspectives. Social competencies are also developed in active learning methods used in natural sciences: group work in problem based learning and solving dilemma problems, analysis of observation and test results and oral presentation of outcomes.

Self-awareness competence. Biology lessons, which examine issues associated with the human anatomy, physiology and healthy lifestyles explain the individual needs for energy and food intake, individuality in healthy exercise, risks related to falling ill and different aspects of healthy lifestyles.

Learning to learn competence. Different study activities develop the skills of solving problems and implementing investigation based learning are developed through different study activities: students acquire the skills for finding natural science information, formulating problems and inquiry questions, planning and carrying out experiments or observations and drawing conclusions. The development of learning to learn competences is supported by ICT-based learning environments, which enable applying different learning strategies by providing quick and individualised feedback.

Communication competence. An important part in the study activities is played by searching for natural science information from different courses including the Internet, analysing the information found and evaluating its veracity. The accurate formulation and written and oral presentations on results from observations and experiments. Also all natural sciences develop the accurate use of terms and symbols characteristic of the corresponding science domains both in abstract scientific and in concrete everyday contexts.

Mathematics and natural sciences and technology competence. Students learn to understand natural science problems, the importance of science and technology and their impact on the society, use new technology and technological tools for solving study task and to make evidence based decisions in everyday life. All natural science subjects also involve preparing and analysing numerical figures, comparing and making associations between different objects and processes. In investigation based learning the data from experiments or observations are presented as table and numerical figures and associations are made between the numerical indicators and the problem being solved.

Entrepreneurial competence. Going through the applied science topics of natural sciences, the everyday reliance on the transference of abstract scientific facts and theories emerges. Along with that, the students gain an overview of professions related to the natural sciences and the research institutions and companies active in the corresponding field. The development of entrepreneurial competences is supported by an investigation based approach to study, where experiments and observations are planned and analysed systematically. An important role is also played by the solving of dilemmas related to the environment and making competent decisions, which aside from scientific perspectives take into account also social aspects.

1.5. Options for Integrating Natural Science Subjects with Other Subject Fields

Language and literature, including foreign languages. Studying natural sciences and working with texts on natural sciences develops the students' skills of understanding and analysing text. Creating different texts, e.g. reports, presentations etc. develops the skill of expressing oneself clearly and relevantly both orally and in writing. Students are taught to use appropriate language tools, subject vocabulary and expressive language and to follow grammatical requirements. The students' skill to look up information from different sources and to critically evaluate this information is developed. Attention is turned to the correct formalization and referencing in the works and the protection of intellectual property. Natural science terms originating from foreign languages are explained and foreign language skills developed also when looking up and understanding additional material.

Math. The shaping of mathematical competence is mostly supported by problem and inquiry-based learning, which develops the students' creative and critical thinking. Inquiry-based learning places great emphasis on the analysis and interpretation of data and presentation of results in tables, graphs and diagrams. In studying natural phenomena, the students apply mathematical models.

Social subjects. Studying natural science subjects helps to understand how the humans and society function, develops the skill of associating the development of the society with the environment, make conscious choices, act as a moral and responsible member of the society and personality.

Art subjects. The shaping of art competence is supported by formulation of research results, making presentations, going to exhibitions, valuing the beauty of nature in study trips etc.

Technology. Learning to understand the simplest patterns of the functioning of nature as a system and the effects of humans and technology on the natural environment develops the technological competence of students. Knowledge in physics creates a theoretical basis for understanding the connections between nature, instruments and technology. Technological competence is developed using technological tools (including information and communication technology) in teaching.

Physical education. Studying natural sciences supports giving value to physical activity and healthy lifestyles.

1.6. Options for Implementing Cross Curricular Topics

Studying natural science subjects is related to all cross curricular topics described in the general part of the national curriculum. The cross curricular topics are taken into consideration when planning the objectives, learning outcomes and study content of the subjects in the subject field based on the stage of study and the specifics of the subject.

Environment and sustainable development. Natural science subjects have a central role in implementing this cross curricular topic.

Lifelong learning and career planning. Skills of independent learning are developed which is an important basis for acquiring the habits and attitudes of lifelong learning. Different study forms are used to develop the communication and cooperation skills of the students, which they require in their future working life. Learning natural science subjects increases the pupils' awareness of career options and gives them information about the options of continuing studies in fields related to natural sciences, the field of nature and environmental protection. Learning activities enable to have direct contact with the working world, e.g. getting acquainted with companies.

Citizens' initiative and entrepreneurship. Sensing civil rights and obligations is related to environmental issues

Cultural identity. Natural sciences form a part of the culture, to which natural scientists linked to Estonia have contributed. The cultural diversity of the world is integrated into population topics in geography.

Information environment. While studying natural sciences, students gather information from different sources of information, evaluate and use this information critically.

Technology and innovation. Natural sciences implement this cross curricular topic by using ICT tools in teaching the subject.

Health and safety. The cross curricular topic "Health and Safety" heavily interrelates with a scientific understanding of the importance of healthy lifestyles and healthy eating as well as the connections between the environment and health. The theoretical basis for suitable health behaviours is primarily established in Biology and Chemistry lessons. All science subjects promote competencies associated with aspects of safety not only for the individual, but for the society in general.

Values and morality. The knowledge and skills related to natural science is ab basis for developing values necessary for preserving life and the living environment.

1.7. Planning and Organizing Study Activities

In planning and organising study activities:

1) the focus is on the basic values, general competences, goals of the subject, learning content and expected learning outcomes of the national curriculum and the course supports integration with other subjects and cross-curricular topics;
2) the aim is to have a moderate study load for students (including homework), ensuring it is distributed across the school year evenly, giving students enough time for rest and recreational activities;
3) possibilities are provided for studying both individually and together with others (pair and group work, study visits and practical work) in order to support the shaping of students into active and independent learners;
4) study tasks are used whose content and level of difficulty support an individualised approach and increase motivation for studying;
5) study environments and study materials and tools based on contemporary information and communication technology are used;
6) the study environment is extended: for example, to computer classes, surroundings of the school, the natural environment, museums, exhibitions, companies etc.;
7) different teaching methods are used, including implementing active learning: role play, discussions, debates, project work, creating a study folder and research paper, practical and research related work (e.g. observing, describing and making conclusions about natural objects and process in the 1st stage of studies, explaining the factors that influence objects, solving complex problems in the 2nd stage of studies, solving problems, modelling molecules and chemical reactions with the help of models, observations, experiments in the 3rd stage of studies) etc.

1.8. Basis for Assessment

Learning outcomes have been described in the subject syllabus by stages of study on two levels: general learning outcomes as educational objectives and learning outcomes by topics. The knowledge and skills of students are determine on the basis of oral responses, written and/or practical work and practical activities, taking into account the individual specificities and development of levels of thinking of each student. The general part of the basic school curriculum is taken as the basis for evaluating the learning outcomes.
The aim of assessment is primarily to support the development and studying motivation of the students. The learning outcomes are evaluated using oral assessment and/or numerical grades. Assessment is also determined for attitude e.g. behaviour (such as showing interest, understanding importance, valuing, taking needs into account, behaving appropriately in nature and appreciating and following rules).

In evaluating written assignments, primarily the content of the work is evaluated, but grammar mistakes are also corrected, which are not taken into account in assessment. The forms of checking learning outcomes must be diverse and in accordance with learning outcomes. The students must know what is being evaluated and when, what forms of assessment are being used and what the criteria of assessment are. Assessment criteria and assessment procedure other than the 5-point system is specified in the school curriculum.

1st stage of study (Science). The knowledge and skills of students are assessed on the basis of oral responses (presentations), written and/or practical work and practical activities, taking into account the correspondence of the students' knowledge and skills to the learning outcomes stated in the curriculum. In evaluating research skills, attention is paid to detecting problems, formulating questions and hypotheses, planning experiments, gathering and presenting data, analysing and interpreting data, drawing conclusions and offering explanations.

2st stage of study (Science). In evaluating inquiry skills, attention is paid to detecting problems, formulating questions and hypotheses, planning experiments, gathering and presenting data, analysing and interpreting data, drawing conclusions and offering explanations. At the same time, the skills of gathering background information, formulating questions, using tools, doing experiments, measuring, gathering data, ensuring accuracy, following safety regulations, analysing tables and diagrams, drawing conclusions and presenting results are also evaluated. The skill of formulating problems and active participation in discussions and expressing and giving reasons for one's opinion are evaluated.

3st stage of study (Science). In evaluating the learning outcomes, it is important to evaluate the development of different levels of thinking in the context of subject as well as the development of research and decision-making skills. The ratio of these for the overall grade could be 80% and 20% respectively. In developing levels of thinking, 50% of the grade should consist of tasks that require the use of lower levels of thinking and 50% higher levels of thinking.

Inquiry skills may be evaluated in the course of research work as well as in developing individual skills separately. The main research skills to be developed in basic school are formulating of problems, collecting of background information, formulating research questions and hypothesis, using tools, doing experiments in a careful and organised way, measuring, gathering data, ensuring accuracy, following safety regulations, compiling and analysing tables and diagrams, drawing conclusions, evaluating of the hypothesis and presenting results.

1.9. Physical Learning Environment

The school organises:

1) practical work in a classroom where there is hot and cold water, sinks, sockets and working desks with a special cover and information and communication technology demonstration apparatus for the teacher;
2) study in groups, if needed, to carry out practical work and study visits;
3) practical work in a classroom where there is hot and cold water, sinks, sockets and working desks with a special cover, at least 4 sets of mobile data collecting instruments and different sensors per class and information and communication technology demonstration apparatus for the teacher. In Chemistry, a fume cupboard is needed for making demonstration experiments. In Geography a set of world atlases and Estonian atlases (one atlas per student). In Biology demonstration microscopes and binoculars that can be connected to a microscope camera.

The school provides:

1) the tools and materials for experiments to carry out the practical work mentioned in the curriculum and equipment for demonstration (microscopes and binoculars that can be connected to a microscope camera).
2) appropriate storage conditions for practical work and demonstrations and collecting and preserving necessary materials (incl. reactives);
3) the possibility use computers to carry out the work listed in the curriculum;
4) the possibility of implementing new ICT solutions in teaching natural sciences on the basis of material capabilities and purposefulness
5) outdoor learning and the students to participate in nature and environmental education projects. In the 2st stage of study are enabled the students at least a twice to take part in environmental centre or science education initiative outside of the school and in the 3st stage of study in every science subject once during the academic year (in the natural environment, at a museum, in a laboratory).

2. Syllabuses
2.1. Science

2.1.1. Learning and Educational Objectives

The aim of teaching natural science is that by the end of the 7th grade, the student would:

1) gain an interest in studying nature;
2) utilise skills to purposefully observe natural phenomena, solve scientific problems in a practical manner and present experimental results;
3) apply scientific methods to solve scientific problems under the supervision of the teacher;
4) apply scientific knowledge to natural phenomena and the connections between animate and inanimate components of the environment;
5) understand the connections between human activity and the natural environment and express concern and respect towards all living things;
6) seek scientific information, evaluate the value of such information and write science text;
7) apply scientific- and technological knowledge and skills to everyday life; and
8) value biodiversity and the need for sustainable development.

2.1.2. Description of the subject

Science is promoted as a subject that integrates the study of knowledge, skills, attitudes and values associated with the science subjects of Biology, Physics, Geography and Chemistry.

Enhancing scientific and technological literacy focuses on developing following competencies:

1) applying science knowledge to everyday life (knowledge of science − knowledge of the different scientific disciplines and the natural world and knowledge about science as a form of human inquiry, scientific explanations, science and technology);
2) applying practical skills and application of scientific methods to solve scientific problems related to everyday life –and
3) utilising attitudes and values in dealing with scientific issues – belief in one's abilities and self-confidence in studying science, interest in studying science and in careers in science, readiness to

make justified decisions associated with everyday issues and taking responsibility as an informed citizen for sustainable development.

The studying of science allow students to begin to acquire an understanding of nature as a whole. In studying science, students gain competencies in observing natural objects, phenomena and processes and exploring the connections between them. Students learn to recognize the relations in nature recognising and appreciating patterns in the way nature functions, the dependence of human beings on the natural environment and the effects of human activities on the natural environment; understanding that every phenomenon happens for a reason and that any change in nature brings about other changes which may be both desirable and undesirable; in acquiring a positive attitude towards all forms of life, and developing a desire and readiness to protect the natural environment and form sustainable values and attitudes.

Science develops competencies associated with critical and creative thinking: the students learn how to notice and observe in a purposeful way; ask questions; gather data and organise this in a systematic way; analyse and draw conclusions, making generalisations; predict the consequences of solutions and decisions within the environment.

Organisation of studies is based on experiencing nature directly and age appropriate activities. Planning studies is based on the scientifically and importance of the problems raised, which in lessons is organized as practical activities with natural objects or their models. The learning environment is active, student-centred and problem based. The studies are related to everyday life and contribute to shaping internal studying motivation.

At the 1st stage of study, the students mainly get to know their surroundings and everyday phenomena. The students develop an interest in nature and the ability to behave properly in nature. By the end of this stage of study, the students move from describing natural phenomena towards making simpler connections and drawing conclusions. General teaching and subject teaching may be combined (in addition to subject-specific teaching). The main practical activities that guarantee the achievement of the learning outcomes of this stage of study are investigation-based and practical activities: observing objects (including natural objects), comparing, grouping, measuring, making experiments, making collections and using plans.

At the 2nd stage of study, the students continue developing their scientific inquiry skills. They develop the ability to think scientifically and creatively, solve problems and formulate scientific questions and hypotheses that can be verified using small-scale experiments. The students develop positive attitudes towards the environment.

At the 3rd stage of study, the students learn to describe objects and phenomena quantitatively and develop skills in processing information analytically. The students develop their competence in understanding the phenomena and methods used in examining these in science.

At both the 2nd and 3rd stages of study, it is important to maintain the students' motivation towards study and to shape their interest in science, science-related careers and their understanding of the importance of science and technology in our everyday lives. To develop competence in attitudes, different study methods are used, including situation- and role play. It is important to plan investigation-based assignments that follow the interests and experiences of the students. In developing investigation skills, special attention is paid to planning and carrying out studies and analysing, interpreting and presenting results. In addition to practical and inquiry-based activities, the students solve various theoretical tasks which guarantee the

development of thinking skills at a higher level. With homework the students consolidate what they learn in the classroom and apply this to activities in everyday life. The studying environment must provide possibilities for the students to be creative.

2.1.3. Learning and Educational Outcomes in the 1st Stage of Study

Values and Attitudes

After completing the 3rd grade of study, students:

1) show interest in studying nature through creativity and imaginative ways;
2) understand that human beings are part of nature, human life depends on nature and consider sustainability as important in their attitude towards nature;
3) observe the beauty and uniqueness of nature and value the diversity and biodiversity of their surroundings;
4) show compassion for animate beings and their needs; and
5) illustrate the capability to move around and be aware of safety aspects in the natural environment safely, without destroying natural resources or hurting themselves.

Inquiry Skills

After completing the 3rd grade of study, students:

1) make simple observations in nature and carry out simple investigatory activities;
2) formulate experiences acquired, with the help of their senses, associated with phenomena and objects;
3) undertake practical work using simple tools, following instructions and safety needs;
4) formulate information gained from observations, draw conclusions and present them both orally and in written formats;
5) express science concepts in appropriate ways through both oral and written formats; and
6) apply science knowledge and skills gained from the study of science in undertaken decisions and appreciating the decisions of others in everyday life.

Observations in nature

After completing the 3rd grade of study, students:

1) make weather observations, record and describe the weather and choose appropriate clothes when going outside;
2) describe natural and artificial objects and phenomena on the basis of information acquired through the different senses;
3) spot changes in nature which can be associated with the changing of seasons;
4) identify forms of life of different organisms and the connections between them during different seasons;
5) relate important seasonal changes that take place in nature to the life of humans;
6) be familiar with, and express through a variety of means, features of the most common species of plants and animals in their living environment; and
7) observe how others relate with nature in positive and negative ways and their appreciation of the need to co-exist with nature.

Natural Phenomena

After completing the 3rd grade of study, students:

1) differentiate between animate and inanimate objects and phenomena and meaningfully observe, describe and group them;

2) differentiate between solid and liquid substances and recognise the potential danger of unknown substances and steps needed to ensure safety for oneself and for others;;

3) undertake practical work guided by instructions while following adequate safety precautions;

4) choosing appropriate measuring tools, determine the mass or weight of objects, the temperature of objects and the lengths correctly, 5) explain the working principle of a compass, and how a compass can be use in everyday life, on the basis of an experiment with a magnet;

6) carry out an experiment to confirm which substances do, or do not, conduct electricity and use the knowledge acquired to safely wire and make use of electric tools; and

7) foresee dangerous situations connected to motion and preventive actions that should be undertaken; give examples of the time and distance required to stop a moving body and the factors which affect this

Diversity and Habitat of Organisms

After completing the 3rd grade of study, students:

1) recognise the importance, giving examples, of the structure of plants, animals and mushrooms, related to their function within the living environment

2) differentiate between mushrooms, plants and animals on the basis of eating, growth and ability to move;

3) illustrate that organisms that belong to the same species are similar;

4) differentiate between fish, amphibians, reptiles, birds and mammals as well as invertebrates (insects) on the basis of living environment, survival of the species and role in the food chain;

5) compare the ways of life and living places of domestic and wild animal species;

6) differentiate between flowering plants, conifers, ferns and moss;

7) indicate the most well-known edible and poisonous mushrooms and the precautions and remedies necessary to avoid the dangers related to poisonous mushrooms;

8) appreciate the needs of plants and animals and approaches necessary for a responsible attitude towards them;

9) compile simple food chains recognising the importance of the Sun; and

10) plan an investigation of one species of plants, mushrooms or animals and make a suitable report compiled by the student which illustrates in a suitable manner observations made, activities undertaken and findings obtained.

Human Beings

After completing the 3rd grade of study, students:

1) describe the outer structure of humans using measuring results;

2) identify with, provide scientific explanations for and enact principles of healthy eating and hygiene so as to illustrate the value of a healthy lifestyle;

3) acknowledge the needs of humans, consume responsibly, avoid damaging their own health or that of others and protect the environment;

4) give examples of how human beings depend on nature and change nature by their activities; and

5) compare people's lives in the countryside and in the city.

Plan and Map

After completing the 3rd grade of study, students:

1) understand simple plans, charts, tables, graphs or maps and determine familiar aspects associated with a plan of the school's surroundings;

2) understand that it is possible to get to know reality on the basis of maps;
3) show their own home areas on the map of Estonia as well as bigger uplands, islands, peninsulas, bays, rivers, lakes and cities;
4) determine north and south with the help of a compass; and
5) describe the location of objects on the basis of the map of Estonia using cardinal points.

2.1.4. Learning Content in the 1st stage of study

2.1.4.1. Human Senses and their role

Senses of humans and their role. Animate and inanimate objects and materials. Comparing solid substances and liquids.

Concepts: property, sense, animate, inanimate, natural, artificial, solid, liquid

Practical work and use of ICT

1. Using the senses in playful and investigatory-based activities.
2. Grouping animate and inanimate objects.
3. Comparing the properties of solid and liquid substances.
4. Illustrate the interdependence of animate and inanimate nature through a study visit to the school surroundings

Attitudes and values: appreciate the manner in which the senses are important to us; indicate steps to be taken to protect, or enhance our senses; illustrates ways of behaviour in aiding person with disabilities to their senses. Demonstrate safety measures in handling solids, for example, heavy objects; and liquids, for example, boiling liquids.

2.1.4.2. Seasons

Changing of seasons in connection with changes in warmth and light. Plants, animals and mushrooms during different seasons. Biodiversity and diversity of landscape in home area.

Concepts: summer, autumn, winter, spring, warmth, light, plants, animals, mushrooms, home environment, water in the environment, landscape

Practical work and use of ICT

1. Study visits to observe seasonal differences and observation of landscape.
2. Observing a tree and the life connected to it throughout the year.
3. Getting to know seasonal changes on the basis of material from the Internet.

2.1.4.3. Organisms and Habitat

Mainland plants and animals. Outer structures and diversity. Forms of life of plants and animals: nutrition and growth. Domestic animals. The difference between water plants and animals and mainland organisms.

Concepts: tree, bush, herbaceous plant, grain, root, stalk, leaf, blossom, fruit, body, head, feet, tail, neck, wings, beak, feathers, fur, scales, nutrition, growth, fins, webbed digits, gills, wild animal, domestic animal, pet

Practical work and use of ICT

1. Nature observations: structure of plants and animals
2. Studying one plant or animal and making an overview
3. Research: the dependence of the growth of a plant on warmth and light
4. Study visit: organisms in different living environments

2.1.4.4. Measuring and Comparing

Weighing and measuring heights and temperature
Concepts: unit of measurement, thermometer, scales, weighing, measuring, experiment
Practical work and use of ICT

1. Weighing of bodies
2. Measuring and comparing the heights of students
3. Measuring temperatures in different environments

2.1.4.5. Human Being

Human being. Outer structure. Human needs for nutrition and healthy eating. Hygiene as an activity that protects health. Living environment of humans.
Concepts: body, body parts, food, health, illness, settlements: city, town, village
Practical work and use of ICT

1. Self-observation and measuring
2. Evaluation of the healthiness of one's daily intake
3. Study visit to examine a settlement as a living environment of humans

2.1.4.6. Weather

Weather observations. Weather phenomena.
Concepts: clouds, wind, air temperature, precipitation: rain, snow

Practical work and use of ICT

1. Weather observation
2. Measuring air temperature
3. Comparing weather predictions and actual weather

2.1.4.7. Groups of Organisms and Cohabitation

Diversity of plants. Diversity of animals. Diversity of mushrooms. Lichens. Species, cohabitation, food chain.
Concepts: flowering plant, fruit, seed, conifer cone, fern, moss, vertebrates, fish, amphibians, reptiles, birds, mammals, scales, invertebrates, worms, insects, spiders, mycelium, cap mushrooms, spores, mould, yeast, lichen, species, cohabitation, herbivore, carnivore, omnivore, food chain
Practical work and use of ICT

1. Compiling a simple collection of a group of organisms
2. Studying the outer structure of an animal and its way of life
3. Observing mushrooms or studying the growth of aspergillus
4. Study visit to observe the cohabitation of organisms in different living environments

2.1.4.8. Motion

Characteristics of motion. Force as the cause of motion (experimentally). Traffic safety.
Concepts: motion, speed, force
Practical work and use of ICT

1. Perceiving the force of one's own body in starting and stopping motion
2. Evaluating the distance and speed of moving bodies

2.1.4.9. Electricity and Magnetism

Circuit. Conductors and non-conductors of electricity. Use and saving of electricity. Safety regulations. Magnetic phenomena. Compass.
Concepts: source of electricity, electric bulb, cord, switch, conductor, non-conductor, safety, compass, cardinal points
Practical work and use of ICT
1. Building a simple circuit
2. Establishing whether substances conduct electricity
3. Introduction to permanent magnets

2.1.4.10. My homeland: Estonia
Plan of the school surroundings. Map of Estonia. Cardinal points and determining their location on a map and in nature. The best known uplands, islands, peninsulas, bays, lakes, rivers and settlements on the map of Estonia.
Concepts: plan, top-down view, map, legend, symbols, colours, cardinal points and intermediate directions, upland, lowland, island, peninsula, bay, lake, river, settlements
Practical work and use of ICT
1. Comparing pictures and plans
2. Moving around the school according to a map and completing a plan without scales
3. Establishing cardinal points on a map and outside with a compass or according to the sun
4. Study tour to get to know the county

2.1.5. Learning and Educational Outcomes in the 2nd Stage of Study

Values and Attitudes
After completing the 6th grade of study, students:
1) are interested in studying natural sciences;
2) value research activities in getting to know nature;
3) value diversity in biology and landscapes and sustainable lifestyle;
4) function as environmentally-aware consumers and value healthy food; and
5) notice the environmental problems in their home areas and Estonia and are motivated to participate in age-appropriate environmental protection events.

Inquiry Skills
After completing the 6th grade of study, students:
1) formulate research questions/problems and verify hypotheses;
2) plan simple practical work under the instructions of the teacher;
3) do experiments, following the guidelines of practical work;
4) discuss the guidelines of scientific research and practical work;
5) use appropriate measuring tools correctly, following safety regulations;
6) analyse data, draw conclusions and present research results;
7) find science-related information from different sources and discuss the reliability of these sources of information; and
8) know how to compare scientific and non-scientific explanations.

General science-related knowledge
After completing the 6th grade of study, students:

1) recognise, in everyday life, scientific topics, problems and questions;
2) understand the science context and interpret and apply the scientific concepts, symbols and units studied when explaining phenomena and processes;
3) rely on science knowledge, draw conclusions and make decisions on the basis of evidence;
4) explain the connections between cause and effect;
5) use or compile a model in order to demonstrate understanding of connections, processes and systems;
6) describe and compare the similarities and differences between organisms, substances or processes;
7) explain the adaptation of organisms in air, water or earth as a living environment and give reasons for the need to protect nature and the environment; and
8) understand the connections between human activities and the environment in the context of their home area and Estonia.

2.1.6. Learning Outcomes and Learning Content in the 2st stage of study

2.1.6.1. Space

Learning Outcomes

The students:

1) describe, on the basis of a plan, the structure of the solar system;
2) explain, with the help of a model, how day and night change on Earth;
3) find the Big Dipper and the Northern Star on the celestial sphere and sky map and establish the direction of north; and
4) find information from different sources about space on a given subject and compile and present an overview.

Learning Content

The sun and the stars. The solar system. Starry sky. Constellations. The Big Dipper and the Northern Star. Galaxies. Astronomy.

Concepts: space, the sun, the Earth, the moon, orbiting, revolving, astronomical day, year, star, planet, satellite, solar system, constellation, the Big Dipper, the Northern Star, galaxy, astronomy

Practical work and use of ICT

1. Making a model to represent the size of the sun and the planets and the distance between them.
2. Modelling the changing of day and night.
3. Modelling the orbit of the Earth.
4. Observations of the starry sky: finding the Northern Star.

2.1.6.2. Planet Earth

Learning Outcomes

The students:

1) describe the geographic location of a given country, including Estonia, according to the political map of the world;
2) know and show on the map the continents and oceans and the largest European countries;
3) find an unknown place on a map in an atlas according to the list of place names; and
4) give examples of different natural disasters and describe their influence on nature and human activities.

Learning Content

Globe as a model of the Earth. Depiction of Earth on maps. Different maps. Continents and oceans. Bigger countries on the map of Europe. Describing geographic location. Estonia's location in Europe. Natural disasters: volcanic eruption, earthquake, hurricane, flood.

Concepts: globe, model, map of nature, map of countries, contour map, atlas, equator, northern and southern hemisphere, north and south pole, continent, ocean, sea, geographic location, border of a country, neighbouring country, volcano, lava, volcanic pipe, earthquake, hurricane, flood

Practical work and use of ICT

1. Making a globe as a model of the Earth.
2. Drawing the studied objects on a contour map.
3. Using different sources to find information and making an overview of natural disaster.

2.1.6.3. Diversity of Life on Earth

Learning Outcomes

The students:

1) know how to use a light microscope;
2) know that all organisms consist of cells;
3) explain the difference between single-celled and multi-celled organisms;
4) name the forms of life of bacteria and their importance in nature and human life;
5) compare the forms of life of plants, animals, mushrooms and bacteria; and
6) give examples of the adaptation of plants and animals in deserts, rainforests, mountain ranges and ice belts.

Learning Content

Diversity of organisms: single-celled and multi-celled organisms. Forms of life of organisms: nutrition, breathing, reproduction, growth, development, reaction to environmental conditions. Life in different environmental conditions. Development of life on Earth.

Concepts: cell, single-celled organism, bacteria, multi-celled organism, nutrition, breathing, reproduction, growth, development, environmental conditions, desert, rainforest, mountain range, ice belt, fossils, giant lizards or dinosaurs

Practical work and use of ICT

1. Observation and comparison of different cells.
2. Building a model of a cell or studying it with the help of multimedia materials.
3. Studying the sprouting of seeds in different environmental conditions.
4. Studying the adaptation of plants and animals in changing environmental conditions
5. Studying the forms of life of organisms in nature

2.1.6.4. Human Being

Learning Outcomes

The students:

1) name the most important human organs (the most important organs of organ systems in humans), describe their tasks and general principles of function and their connections;
2) know that humans and their predecessors belong to the animal kingdom;
3) associate the organs of humans and other organisms with their functions;
4) compare humans with vertebrates;
5) analyse the functions of a human organ or group of organs on the basis of a simple experiment or model;

6) give examples of the importance of plants, animals, mushrooms and bacteria in the life of humans; and
7) explain the principles of healthy lifestyles and compile a healthy daily menu.

Learning Content

Structure of humans: organs and organ systems. Tasks of organ systems. Integrity of the organism. Healthy lifestyles. Human genealogy. Comparison of humans with vertebrates. Plants, animals, mushrooms and micro-organisms at the use of humans.

Concepts: organ, tissue, skin, muscles, skeleton, heart, blood vessel, artery, vein, lungs, liver, stomach, bowels, small intestine, large intestine, gut opening, sense organs, nerves, brain, spinal cord, testicles, ovaries, uterus, fertilisation, glands, kidneys

Practical work and use of ICT

1. Making a model of an organ and/or studying its functions.
2. Experiments and laboratory work in order to study the functions of human organs.
3. Overview of the connections of humans with one species of plants, animals, mushrooms or groups of bacteria.
4. Analysing menus and following the principles of healthy eating.

2.1.6.5. Rivers and Lakes: Water as a Living Environment

Learning Outcomes

The students:

1) describe the application of the inquiry to study a body of water;
2) know how to conduct a inquiry about a body of water and present the results of the study;
3) name and show on a map the biggest rivers and lakes in Estonia;
4) characterise and compare given rivers on the basis of a map and pictures (location, head and mouth of the river, associating the falling and speed of flow);
5) describe water as a living environment, describe the differences in living conditions in rivers and lakes and explain the importance of the circulation of water in lakes;
6) describe the biota of rivers and lakes and name the most typical types of rivers and lakes;
7) give examples of the adaptation of plants and animals to life in water and near bodies of water; and
8) compile food chains/webs for the bodies of water studied.

Learning Content

Scientific inquiry. A body of water as an phenomenon of study. Estonian rivers. River and its parts. River water currents . The fluctuation of the water level in a river. Estonian lakes and their location. The adaptation of plants and animals to life in water. River as a living environment. Properties of lake water. Nutrient content in lake water. Living conditions in a lake. Life in rivers and lakes. Formation of food chains and food webs of producers, consumers and decomposers. Importance, use and protection of rivers and lakes. Fish breeding.

Concepts: river, river bed, mouth of a river, head of a river, main stem, tributary, confluence, river fall, speed of current, rapid, falls, high water, low water, lake, seepage lake, drainage lake, beach lake, producers, consumers, decomposers, food chain, food web, plankton, green algae, water flea, algal bloom, shoreline plants, aquatic plants, herbivorous fish, carnivorous fish

Practical work and use of ICT

1. Scientific inquiry using the example of a body of water near the student's home area: formulating a problem and research questions, gathering and analysing data and generalising and presenting results.
2. Comparing two Estonian rivers or lakes on the basis of a map or other sources of information
3. Establishing water organisms on the basis of simple tables.

4. Studying the vital functions of pondweed.
5. Getting to know the sounds of wildlife using audiovisual materials.

2.1.6.6. Water as a Substance: Use of Water

Learning Outcomes

The students:

1) describe the states of water and name the temperature for the melting of ice, freezing and boiling of water;
2) experimentally study the properties of water and methods to purify water according to instructions;
3) explain the formation of groundwater and compare the water transmission of different types of soil;
4) describe the possibilities of obtaining drinking water and explain the need to use water sparingly; and
5) give examples of the effect of human activities and consequences of pollution on bodies of water.

Learning Content

Properties of water. States of water and their changing. Properties of liquid and gas substances. Thermal expansion of water. Wetting and capillarity. Groundwater. Drinking water. Use of water. Pollution and protection of water. Purification of water.

Concepts: substance, solid, liquid, gas, evaporation, deliquesce, solidification, melting, thermal expansion, wetting, capillarity, state of a substance, compressibility, fluidity, volatility, groundwater, source, drinking water, precipitation, screening, filtration

Practical work and use of ICT

1. Studying the properties of water (change in states of water, thermal expansion of water, movement of water upon heating, wetting, capillarity).
2. Comparing different kinds of water.
3. Movement of water in different soils.
4. Purification of water in different ways.
5. Studying the use of water at home or school.

2.1.6.7. Settlements as Living Environments

Learning Outcomes

The students:

1) show Estonian county centres and bigger cities on a map;
2) compare their own area with another according to different sources of information;
3) describe the living conditions in a settlement and give examples of human-companion animals;
4) compile food chains that characterise a settlement;
5) compare environmental conditions in a settlement and city;
6) give examples of factors that damage a settlement's biota and the health of humans;
7) assess the condition of the air in their area on the basis of the appearance of lichen; and
8) make proposals to improve the environmental conditions in their home area.

Learning Content

Living environment in a countryside settlement and city. Estonian cities. Plan of home area. Living conditions in a settlement. Plants and animals in a settlement.

Concepts: artificial community, plan of a settlement, parasite, human-companion animal, ~~weed,~~ park

Practical work and use of ICT

1. Compiling an overview introducing Estonia or the student's home country.
2. Study visit to get to know the biota of a settlement.

3. Studying the environmental condition of a home settlement.
4. Settlement of my dreams – compiling a model of an environmentally friendly living environment.

2.1.6.8. Landforms and Groups of Landforms

Learning Outcomes

The students:

1) describe the shape and absolute and relative altitude of landforms and the inclination of slopes on the basis of contour lines;
2) describe the groups of landforms of their home counties and Estonia, naming and showing them on a map;
3) give examples of the effects of continental glaciers on the shaping of groups of landforms in Estonia; and
4) explain the effect of landforms on human activities and give examples of the effects of human activities on the landforms in their home areas.

Learning Content

Landforms and their depiction on a map. Landforms and groups of landforms of home area and Estonia. Higher uplands, lowlands and plains. North-Estonian Glint. The role of continental glaciers in shaping landforms. The effect of landforms on human activities and the landforms created by humans

Concepts: landforms, hill, valley, dell, mountain, slope, foot of a hill, contour line, relative and absolute altitude, uplands, plain, lowlands, glint, group of landforms, continental glacier, terminal moraine, glacial boulder

Practical work and use of ICT

1. Compiling a model of a hill and depicting a hill on a map with contour lines.
2. Describing the landforms and groups of landforms in the student's home area.

2.1.6.9. Bogs as Living Environments

Learning Outcomes

The students:

1) describe, according to a map, the location of bogs in Estonia and their own home county;
2) know how to explain why there are so many bogs in Estonia;
3) explain the formation and development of bogs;
4) associate the specificity of a raised bog as a living environment with the structure and properties of sphagnum moss;
5) compare the growth conditions for plants in fens and raised bogs;
6) compile food chains that characterise bog communities; and
7) explain the importance of bogs and the need for their protection.

Learning Content

Bog as living environment. Formation and location of wetlands. Development of wetlands: fen, transition mire and raised bog. Living condition in a bog. Biota of bogs. Importance of bogs. Use of peat. Technology of producing peat.

Concepts: fen, transition mire, raised bog, hollow, sphagnum moss, peat.

Practical work and use of ICT

1. Studying bog communities on the basis of a study visit, models or Internet materials.
2. Studying the properties of sphagnum moss.
3. Compiling a collection during a study visit.

2.1.6.10. Soils as Living Environments

Learning Outcomes

The students:

1) describe and compare different soil samples, naming the components of soil;
2) determine experimentally whether soil contains air and water;
3) explain the formation of soils and the importance of soil in nature;
4) determine the humus horizon in a soil pit; and
5) describe the formation of humus and its role in the biogeochemical cycle.

Learning Content

Components of soil. Formation and development of soils. Soil organisms. Biogeochemical cycle. Role of soil in communities. Soil pit. Movement of water in soil.

Concepts: soil, biogeochemical cycle, weathering of rocks, solid part of soil, soil grains, soil air, soil water, humus, humus horizon, sand soil, clay soil

Practical work and use of ICT

1. Taking, describing and comparing soil samples and making compost.
2. Establishing the water and air content of soil.
3. Comparing soil and peat.
4. Describing a soil pit using the example of a community studied (garden, field, forest, meadow).

2.1.6.11. Gardens and Fields as Living Environments

Learning Outcomes

The students:

1) explain the importance of photosynthesis in the formation of organic substance;
2) describe soil biota and give examples of associations between different soil organisms;
3) highlight the similarities between garden and field communities and explain the role of humans in the formation of these communities;
4) know the cultivated plants studied and group them;
5) compile food chains/webs of the species studied;
6) give examples of the factors that influence productivity;
7) compare chemical and biological repellents and give reasons why organic products should be preferred;
8) give examples of the reasons for and effects of damage to soils; and
9) give examples of the role of agricultural produce in everyday food.

Learning Content

Fertility of soil. Garden as a community. Photosynthesis. Garden plans. Fruit and vegetable gardens and decorative gardens. Field as a community. The effect of chemical repellents on nature. Organic farming. The effect of human activity on soil. Pollution and destruction of soil. Protection of soil.

Concepts: photosynthesis, fertiliser, cropping, leguminous plants, protuberance bacteria, symbiosis, cultivated plants, weed, pest, plant diseases, chemical repellents, biological repellents, organic farming, vegetables and fruits, variety, aromatic herb, medicinal plants, decorative garden.

Practical work and use of ICT

1. Studying how compost is formed.
2. Studying the biota connected to a garden or field plant.
3. Describing and comparing garden and field plants using concrete examples or Internet-based study material.

4. Studying the role of garden and field produce in everyday food or how one type of agricultural produce (including animal products) is processed into food.

2.1.6.12. Forests as Living Environments

Learning Outcomes

The students:

1) describe forests as ecological systems, including environmental conditions in forests;
2) compare the adaptations of pines and spruces;
3) describe and compare the main types of forests according to growth conditions;
4) compare plants growing in different layers of types of forests;
5) compile food chains/webs that characterise forest biota;
6) explain how to protect the biodiversity of forests; and
7) explain how natural and economic forests are formed and name the principles of sustainable forestry.

Learning Content

Living conditions in a forest. Forest as biota. Estonian forests. Layers of forest. Heathland forest, pine forest, deciduous forest. Typical types of Estonian forests, connections between them. Importance and use of forests. Processing of wood. Protection of forests.

Concepts: ecosystem, primeval forest, natural forest, economic forest, wild game, cloven-hoofed animals, top predator, layers of forest, types of forests: heathland forest, pine forest, deciduous forest.

Practical work and use of ICT

1. Getting to know forests as communities together with their biota.
2. Comparing the dominant types of trees in Estonian forests using examples or Internet-based study materials.
3. Research: forests in everyday life/utility items connected to forests.
4. Studying the tracks of forest animals.

2.1.6.13. Air

Learning Outcomes

The students:

1) measure air temperature outside, assess cloudiness and speed of wind and establish types of clouds and direction of wind;
2) compare weather in different parts of Estonia according to a weather map (temperature, direction of wind, speed, cloudiness, precipitation);
3) describe, on the basis of a chart, the average temperatures and amount of precipitation and the prevalent winds in Estonia with the help of a wind rose;
4) describe, on the basis of a picture or diagram, the hydrologic cycle;
5) describe air as a living environment and describe the differences in living conditions in water and in air;
6) explain the role of oxygen in burning, naturalising and breathing of organisms and the importance of oxygen for organisms;
7) know that carbon dioxide is produced in burning, naturalising and breathing of organisms;
8) give examples of adaptation to the air environment of animals and plants; and
9) name the reasons for and consequences of air pollution and give examples of how to prevent air pollution.

Learning Content

Importance of air. Composition of air. Properties of air. Air temperature and its measurement. Change in air temperature during astronomical day. Movement of air when warming up. Movement of air and wind. Dry and humid air. Clouds and precipitation. Hydrologic cycle. Weather and climate. Measurement of precipitation. Weather forecast.
Importance of oxygen in natural processes: breathing, burning and naturalising. Air as a living environment. Adaptation of organisms to air environment. Prevention of air pollution.
Concepts: air mass, air, gas, oxygen, carbon dioxide, nitrogen, wind, speed of wind, direction of wind, condensation, clouds, precipitation, hydrologic cycle, weather, climate, breathing, burning, naturalising, pollination
Practical work and use of ICT

1. Studying the properties and composition of air: burning of a candle in a closed receptacle, compressibility of air, expansion of air when warming up, condensation of steam.
2. Measuring temperature, establishing cloudiness and direction of wind and evaluating the speed of wind.
3. Comparing the weather in different parts of Estonia according to weather maps on the website of the Estonian Meteorological and Hydrological Institute (EMHI).

2.1.6.14. The Baltic Sea as a Living Environment

Learning Outcomes
The students:

1) show the countries around the Baltic Sea and bigger bays, straits, islands and peninsulas on a map;
2) compare the temperatures of coastal areas and inland according to weather maps, graphs and tables;
3) describe the settlements and human activities around the Baltic Sea on the basis of the example of an area studied;
4) describe the Baltic Sea as an ecosystem;
5) explain the reasons for the low level of salt in the Baltic Sea and the specificities of the biota of a brackish water body;
6) compare the living conditions of organisms in lakes and in the sea;
7) describe the spread of algae in the Baltic Sea;
8) establish, according to tables, the vertebrates and invertebrates of the Baltic Sea;
9) compile food chains/webs characteristic of the Baltic Sea; and
10) explain the reasons for the pollution of the Baltic Sea and ways of protecting it.

Learning Content
Water in the Baltic Sea: properties of sea water. The location of the Baltic Sea and its neighbouring countries, biggest bays, straits, islands, peninsulas. The effect of the Baltic Sea on the weather. The coast of the Baltic Sea. Living conditions in the Baltic Sea. The biota of the sea, coast and islands and characteristic species and their connections. The effect of the sea on human activities and the formation of coastal settlements. Pollution and protection of the Baltic Sea.
Concepts: saltiness of water, mixture, solution, solvent, brackish water, coastline, shore, coast, flat coast and steep coast, land and sea breeze, green algae, brown and red seaweed, benthic animals, highly migratory species of fish, coastal birds
Practical work and use of ICT

1. Making solutions with different levels of saltiness in order to compare the saltiness of the Baltic Sea and oceans and to test the vaporisation of salty water.
2. Drawing a map of the Baltic Sea from memory (imaginary map).

3. Describing the Baltic Sea, its biota, coastal settlement and human activities on the basis of difference sources of information.
4. Studying the effect of oil pollution on the biota.
5. Analysing the problems of the Baltic Sea using different sources.

2.1.6.15. The Living Environment in Estonia

Learning Outcomes

The students:

1) describe the role of producers, consumers and decomposers in the biogeochemical cycle and explain food relations in the ecosystem;
2) describe the animate and inanimate parts of the ecosystem and explain the importance of natural balance in ecosystems;
3) gives reasons for the importance of the biogeochemical cycle;
4) describe human effects on the natural environment and explain how changes in the environment can cause changes in the biota;
5) compile food chains/webs that exist between different communities; and
6) explain food relations: parasitism, predation, symbiosis and competition.

Learning Content

Overview of the diversity of wildlife in Estonia. Producers, consumers and decomposers. Food relations in ecosystem. Human effects on ecosystems.

Concepts: food web, detritus cycle, energy, parasitism, predation, symbiosis, competition

Practical work and use of ICT

1. Studying ecosystems on the basis of models.
2. Using Internet-based learning environments to study food chains and food webs.

2.1.6.16. Estonia's Natural Resources

Learning Outcomes

The students:

1) name the renewable and non-renewable natural resources in Estonia and give examples of their use;
2) distinguish between granite, limestone, oil shale, sand, gravel and peat;
3) give examples of ways of producing and using renewable energy in their home area; and
4) explain the need for reasonable consumption, following the connection between natural resources, consumption and waste.

Learning Content

Estonia's natural resources, their use and protection. Natural resources as sources of energy. Estonian minerals, mining and use. Environmental problems connected to the use of mines and strip mines.

Concepts: natural resources, renewable and non-renewable natural resources, minerals, silt, sand, gravel, clay, peat, stone, limestone, granite, oil shale, strip mine, underground mine, energy, heat and electrical energy

Practical work and application of information and communication technology

1. Describing and comparing silt and stone.
2. Study of energy consumption at home/school.
3. Compiling an overview of the use of natural resources in the student's home area.

2.1.6.17. Nature and Environmental Protection in Estonia

Learning Outcomes

The students:

1) explain the need for nature protection and give examples of protected areas, protected species and single objects;
2) describe the location of protected areas in Estonia, including in their own home area, according to a map;
3) explain the biodiversity of meadows as one of the most species-rich communities in Estonia and the need to protect them;
4) explain the need for environmental protection;
5) give reasons for the need to separate and recycle household waste;
6) analyse their own consumption and that of their families and assess its effect on the environment; and
7) give examples of the environmental problems of their home area and Estonia and propose ways of solving them.

Learning Content

Human effect on the environment. Nature protection in Estonia. Protection of biodiversity. Nature reserves. Meadows as the most species-rich community in Estonia. The changing of the natural environment in the home area due to human activities. Waste management. Sustainable consumption.

Concepts: nature protection, biodiversity, natural meadow, cultivated meadow, woodland, biocenosis, environmental protection, waste, eco-label, protected, nature reserves: wildlife preserve, national park, landscape reserve

Practical work and use of ICT

1. Studying the environmental effects of an enterprise in the student's home area or giving an overview of one environmental problem in their home area.
2. Compiling an individual plan of action for environmentally friendly behaviour.
3. Compiling an overview of one protected species or nature reserve on the basis of different sources of information.
4. Study trip to a nature reserve.

2.1.7. in the 3rd Stage of Study

Values and Attitudes

After completing the 7th grade of study, students:

1) show an interest in studying natural sciences and are interested in a career in natural sciences and technology;
2) value research activities in getting to know natural phenomena, confidently use creativity;
3) believe in their own abilities and are confident in studying natural phenomena; and
4) value order in doing experiments, follow rules that are agreed upon and take care of tools for experiments;
5) value the diversity of living and non-living nature.

Inquiry Skills

After completing the 6th grade of study, students:

1) are able to view and ask questions regarding natural sciences;
2) formulate a research problem or hypothesis, which can be verified by an experiment of observations;
3) are able to plan and carry out in cooperation with other students a study, including an experiment;
4) are able to suggest measurable and unmeasurable variables;
5) differentiate between an independent and dependent variable in an simple experiment;
6) analyse the trustworthiness of data, understands the need for repeat tests and verification tests and the need to check auxiliary variables;
7) present results as tables and diagrams;
8) are able to bring out associations in data collections presented both graphically and non-graphically;
9) make conclusions on the basis of collected data, explain and predict results and evaluate the validity of hypotheses;
10) present the results of a study orally and verbally and in a visually understandable manner;
11) apply mathematical knowledge/skills when solving natural science problems;
12) follow instructions and safety requirements when carrying out experiments;
13) justify the need for natural science knowledge in everyday life.

2.1.8. Learning Outcomes in the 3rd Stage of Study

Humans studying nature

After completing the 7th grade of study, students:

1) understand the importance of natural sciences and technology in everyday life;
2) differentiate between scientific knowledge and unscientific knowledge;
3) describe the properties of bodies both qualitatively and quantitatively;
4) measure or determine the length, surface area, volume, mass of a body;
5) associates the knowledge acquired in natural sciences with previously acquired knowledge and skills.

Variability of substances and bodies

After completing the 7th grade of study, students:

1) know that all substances consist of particles: atoms or molecules and that molecules consist of atoms;
2) know the symbols of hydrogen, oxygen and carbon, also the formula for these simple substances, water and carbon dioxide;
3) know how to make a solution and give examples of soluble substances and solutions and explain the importance of solutions in nature;
4) separate a mixture using appropriate methods;
5) know that pure substances have specific properties;
6) differentiate substances according to their properties (colour, density, melting and boiling point or thermal conductivity);
7) understand the importance of models, select a suitable model for explaining a specific phenomenon;
8) explain how solids retain their shape and hardness, liquids their fluidity and gases their volatility with the interaction of particles.

Natural phenomena

After completing the 7th grade of study, students:

1) differentiate between physical, chemical and biological phenomena, explains associations between them;
2) measure the velocity of a body and covered distance;
3) bring examples of motion in living and non-living nature;
4) bring examples from everyday life where energy transforms or is transformed from one type to another;
5) classify different materials on the basis of their thermal conductivity and associates the thermal conductivity of the materials with their applications; associates the changes in the state of water with different precipitation (rain, snow, dew, fog, frost);
6) explain, on the example pf photosynthesis, breathing and burning, that chemical reactions may ether absorb or release energy;
7) explain the impact of physical factors (heat, light, humidity) on the growth and development of living organisms.

Associations between animate and inanimate species

After completing the 7th grade of study, students:

1) describe the associations between animate and inanimate species on the example of the carbon cycle;
2) explain the need for conserving energy;
3) associate adaptations with physical and chemical environmental conditions;
4) present ideas of reusing materials;
5) analyse the possible environmental impact, ecological footprint of their own activities.

2.1.9. Learning Content in the 3rd Stage of Studies

2.1.9.1. Human Studying Nature

Learning content

Natural sciences and technology. Scientific method. Stages of a study. Observation and experiment. Measuring in natural sciences, measuring tools, measuring units, reliability of measurement results. Presenting data in a graphical format.

Keywords: measuring, measuring unit, measuring tool, physical quantity, length, surface area, volume, mass, counting.

Practical work and use of ICT:

1) investigating measurement tools (including digital);
2) measuring the length, surface area and volume of a body, evaluating the reliability of the results;
3) observing, describing and measuring biological, geographical or local history objects;
4) compiling a plan in a building or on landscape: marking objects on the plan with symbols, measuring distances (measuring by eye, steps, tape measure), determining directions.

2.1.9.2. Variability of substances and bodies

Learning content

Structure of substances and bodies: atom, molecule, cell. Chemical element, periodic table. Simple and complex substances, their formulae. Distribution of chemical elements. States of a substance. Density of a substance. Pure substances and mixtures, materials and solutions.

Keywords: atom, atomic nucleus, electron shell, molecule, pure substance, mixture, solution, density, simple and complex substance, minerals, rocks, natural science model.

Practical work and ICT:

1) looking up information from information sources about the chemical elements around us (rocks, natural water, air, human being, space), comparing and evaluating this information;
2) investigating the properties of solutions with different salt concentration (density, freezing point), analysing results (interpreting charts) and applying the associations find (freezing point of salty water, floatability of bodies);
3) separating a mixture into its components by using concentration, seeping, filtering, vaporising, distillation;
4) investigating the phase transitions of substances at a molecular level by using a computer model;
5) determining the density of a substance/material/body;
6) making models of a molecule, cell and solar system with simpler tools.

2.1.9.3. Natural phenomena

Learning content

Physical, chemical and biological phenomena. Motion and velocity. Energy. Types of energy. Transfer and transformation of energy. Thermal conductivity, good and bad thermal conductors around us and within us. Chemical reaction. Growth and development of organisms.

Keywords: energy, mechanical motion, trajectory, distance, time, velocity, chemical reaction, burning, breathing, decomposition, photosynthesis.

Practical work and use of ICT:

1) measuring velocity;
2) energy transfer – graphically depicting the heating and cooling of different materials;
3) investigating a chemical reaction using everyday substances;
4) investigating the burning process of different substances;
5) the heat released from a burning candle being transferred to the surrounding environment;
6) transforming chemical energy into electric energy;
7) breathing and photosynthesis – measuring CO_2 and O_2 with digital data collators;
8) investigating the emergence of fog and frost.

2.1.9.4. Associations between animate and inanimate species

Learning content

Human studying ecosystems. Carbon cycle in ecosystems. Adaptation with physical-chemical conditions/living environment. Human activity, technology and natural balance. Energy consumption and recovery of materials.

Keywords: carbon cycle, adapting and adaptation, green house effect.

Practical work and use of ICT:

1) investigating the carbon cycle on the example of trees and wood, including determining the age of a tree with the help of growth rings;
2) investigating the ecosystems and landscape of the home or school surroundings with the help of satellite images;
3) investigating the impact of physical-chemical environmental conditions with the help of scientific models, including simulating the greenhouse effect;
4) investigating the adaptive changes in plants and animals with the help of online materials;
5) investigating the circulation of a product (e.g. paper) from raw material to recycling;
6) making a product out of reusable materials;
7) calculating and analysing the economical footprint of a family.

2.2. Biology

2.2.1. Biology Learning and Educational Objectives

The study of the subject of Biology in basic school is to develop competencies so that students have the capability to:

1) be interested in biology and other natural sciences and understand their importance in and connections to everyday life and the development of humankind and technology;
2) take a responsible attitude towards the living environment, valuing biodiversity, sustainable and responsible lifestyles and principles of sustainable development;
3) acquire an overview of wildlife, its most important processes, relations between organisms and relations with the inanimate environment and use correct biology-related vocabulary;
4) solve problems, using (among other things) scientific method and make decisions that are based on scientific, social, economic, ethical and moral viewpoints and legislation;
5) plan, carry out and analyse natural scientific inquiries and present the results attained;
6) use different sources of information and critically assess the information they contain;
7) use technological resources when studying biology, including the possibilities of information and communication technology;
8) gain an overview of professions connected to biology and the necessity of biology-related knowledge and skills for different areas of work; and
9) develop scientific and technological literacy, especially creativity and systematic thinking and to be motivated for lifelong learning.

2.2.2. Biology subject description

Competencies to be gained through the study of biology are based on knowledge, skills attitudes and values acquired in science classes and are closely connected to studies in Geography, Physics, Chemistry and Mathematics. The study of the subject of Biology, the students are expected to acquire a positive attitude towards all things living and value sustainable and responsible ways of life. The aim is also to shape a positive attitudes towards biology as a natural science which takes scientific, economic, social, ethical and moral aspects and legislation into account when solving everyday problems.

Important competencies to be gained through Biology lessons in basic school are that students:
gain a complete overview of the principles of the diversity of wildlife, structure and function, heredity, evolution and ecology and wildlife protection, acquire the concepts used in the sub-fields of biology and introduce the uniqueness of humans and healthy lifestyles. Biology-related knowledge is acquired to a large extent through inquiry-related tasks that are based on scientific methods and through which the students acquire skills to formulate problems and hypotheses, planning and arranging experiments or observations and analysing and interpreting results. An important role is also played by oral and written presentations of investigation results, including verbal and visual forms of presentation.

An important role is also played by skills needed to solve problems in everyday life and make competent decisions which increase the students' ability to manage in the natural and social environment. The knowledge, skills, attitudes and values acquired through Biology lessons, together with studies in other subjects, are intended to form a basis for motivated lifelong learning.

The study is student-centred and develop motivation. In developing different forms of cooperation, the age and individual specificities of students are taken into account. The study activities that follow the basis of scientific methods, solving problems arising from the natural, technological and social environment. This involves the development of the students' higher levels of thinking. The students gain an overview of the main achievements, patterns, theories and future orientations of biology, which also helps them in their future career choices. The students' knowledge and skills in biology, enable them to understand, explain and predict different natural phenomena. The main terms specified in the subject syllabus are an important precondition for achieving the learning outcome.

2.2.3. Learning and Educational Objectives in the 3rd stage of studies

After completing the 9th grade, students:

1) understand the most important processes of wildlife, relations between organisms and relations with the inanimate environment and use correct biology-related vocabulary;
2) have acquired a systemic overview of wildlife objects, the harmony between their structure and function and value biodiversity;
3) use biology-related knowledge and the scientific method, solving wildlife and everyday problems and making decisions that are based on scientific, social, economic, ethical and moral viewpoints and legislation;
4) successfully plan, carry out and analyse age-appropriate inquiries and present the results attained in a purposeful form;
5) use different biology-related sources of information, analyse, synthesise and critically assess the information they contain and apply this successfully in explaining processes taking place in wildlife, describing objects and solving problems;
6) use technological resources purposefully when studying biology, including the possibilities of information and communication technology;
7) have acquired an overview of professions connected to biology and use biology-related knowledge and skills in making career choices; and
8) acknowledge the connections between biology, technology and society and are internally motivated for lifelong learning.

2.2.4. Learning Outcomes and Learning Content of Biology in the 3st stage of study

2.2.4.1. Biology as a Field of Study Area of research in Biology Research area in Biology?

Learning Outcomes

The students:

1) explain the connection of biology studies to other sciences and everyday life as well as the development of technology;
2) analyse the necessity of biology-related knowledge and skills in different professions;
3) compare the external characteristics of animals, plants, mushrooms, protozoa and bacteria;
4) divide organisms according to pictures and descriptions into animals, plants and mushrooms;
5) associate forms of life with different groups of organisms;
6) make wet preparations and use a light microscope to study them; and
7) value scientific methods when drawing trustworthy conclusions.

Learning Content

Content of biology and relation to other natural sciences and role in developing contemporary technologies. Main research methods of biology: observations and experiments. Stages and application of scientific method. Division of organisms into animals, plants, mushrooms, protozoa and bacteria and comparison of their external characteristics. Forms of life of representatives of different groups of organisms.
Concepts: biology, organism, observation, experiment
Practical work and use of ICT
1. Preparing a wet preparation and comparing different objects with a microscope.
2. Comparing the external characteristics of different groups of organisms on the basis of real objects or information acquired from the Internet.

2.2.4.2. Characteristics of Vertebrates
Learning Outcomes
The students:
1) associate the external characteristics of mammals, birds, reptiles, amphibians and fish with their living environments;
2) analyse the importance of different senses of vertebrates depending on where and how they live;
3) analyse the role different vertebrates play in nature and human activities;
4) find and analyse information about the protection, catching and hunting of animals; and
5) value the protection of vertebrates.

Learning Content
Division of animals into vertebrates and invertebrates. Connection between the external characteristics of vertebrates and their living environment. Main sense organs of vertebrates for orientating in the living environment. The dependence of the main senses of vertebrates on their lifestyle. The role of mammals, birds, reptiles, amphibians and fish in nature and human activities. Rules connected to catching, hunting and protection of animals. The role of vertebrates in the ecosystem.
Concepts: vertebrate, invertebrate, sense organ, living environment, living place
Practical work and use of ICT
Analysing the vital functions of vertebrates and mapping their diversity in the school surroundings.

2.2.4.3. Metabolism and Energy Transformation of Vertebrates
Learning Outcomes
The students:
1) analyse the connections between the different processes of metabolism and energy transformation and explain their occurrence in nature and the everyday life of humans;
2) associate ways of obtaining food and the character of the gastrointestinal system with the food objects of vertebrates;
3) explain and compare the functions of the respiratory systems of different vertebrates;
4) compare warm-blooded and cold-blooded organisms and give examples of them;
5) analyse the characteristics of the structure of the heart and blood circulation of different groups of vertebrates and associate them with being warm-blooded and cold-blooded;
6) compare the adaptations of vertebrates in ensuring stable body temperature; and
7) assess the survival strategies for unfavourable seasons among vertebrates.

Learning Content
Main processes of metabolism and energy transformation. Differences in herbivorous, carnivorous and omnivorous vertebrates due to food objects. Ways of gathering food and adaptations related to this.

Characteristics of gastrointestinal systems of vertebrates depending on food: structure of teeth, length of intestines and time taken to digest food.
Diversity in the structure and function of respiratory systems of different groups of vertebrates: gills in organisms that live in water and lungs in organisms that live in air environment, specificities of lungs in birds, breathing through the skin.
Changes in body temperature of warm-blooded and cold-blooded animals. Comparison of hearts and blood circulation of different groups of vertebrates and ways of surviving unfavourable seasons.
Concepts: metabolism, breathing, digestion, organ, heart, systemic circulation, pulmonary circulation, gills, lungs, air sac, stomach, intestines, cloaca, warm-blooded, cold-blooded, carnivorous, herbivorous, omnivore, herbivorous fish, carnivorous fish, predator, prey

Practical work and use of ICT

Selecting a research paper on the computer about the effect of food or oxygen on the vital functions of organisms.

2.2.4.4. Reproduction and Development of Vertebrates

Learning Outcomes

The students:

1) analyse the advantages of internal and external fertilisation and foetal development in vertebrates and give examples of this;
2) give examples of vertebrates in which internal and external fertilisation occurs;
3) assess the importance of direct development and metamorphosis and give examples of this; and
4) compare the importance of feeding, protecting and teaching young in different groups of vertebrates.

Learning Content

The factors that influence the reproduction of vertebrates. Comparison of internal and external fertilisation. Comparison of internally and externally fertilised foetal development of different vertebrates. Birth and post-embryonic development. Comparison of metamorphosis and direct development. Taking care of offspring (feeding, protecting and teaching) in different vertebrates and the connection between the need for care and the specificities of reproduction and development.
Concepts: anisogamy, sexual reproduction, ovum, sperm, internal fertilisation, external fertilisation, incubation, direct development, metamorphosis.

2.2.4.5. Features and Life Processes of Plants

Learning Outcomes

The students:

1) compare the external characteristics, means of reproduction, location of growth and distribution characteristic of different groups of plants;
2) analyse the role of plants in ensuring the sustainability of nature as a complete system and in human activities and give examples of this;
3) explain how knowledge of plants is necessary for representatives of different professions;
4) differentiate between animal and plant cells and their main parts in drawings and microphotos;
5) analyse the dependence of the structure of organs of flowering plants on their tasks, location of growth and means of reproduction and distribution and associate the function of plant organs with the movement of substances in the plant;

6) compile and analyse schemes of source material of photosynthesis, its end products and the conditions that influence the process and explain the role of photosynthesis in the vital functions of plants, animals, mushrooms and bacteria;
7) analyse the advantages of sexual and asexual reproduction on the example of different plants, compare different means of reproduction, pollination and distribution and give examples of these; and
8) take a responsible attitude towards living organisms.

Learning Content

The main structural and functional differences of plants in comparison with vertebrates. Main features of the external structures of flowering plants, gymnospermous plants, pteridophyte plants, bryophyte plants and alga. The role of plants in nature and human activities. The professions related to studying and growing plants. Comparison of reproduction, location of growth and distribution characteristic of different groups of plants.

Comparison of plant cells with animal cells. The structure and function of the main parts of plant and animal cells.

The harmony between the structure and function of the organs of flowering plants. The general Learning of development of photosynthesis, its importance and connection with breathing. Capillary action and downward movement in plants. Sexual and asexual reproduction, comparison of entomophily and anemophily, adaptation of plants for distribution, including distribution by animals and wind. The necessary conditions for the germination of seeds and development of plants.

Concepts: cell, cell membrane, cell nucleus, mitochondrion, chlorophyll, chloroplast, chromoplast, vacuole, tissue, stoma, capillary action, downward movement, photosynthesis, inorganic substance, organic substance, flower, anther, pistil, pollination, seed, fruit, cone, asexual reproduction, reproduction by spores, spore, vegetative reproduction

Practical work and use of ICT

1. Mapping the diversity of plants around the school.
2. Studying the factors that influence photosynthesis using practical work or a computer model.

2.2.4.6. Characteristics and Life Processes of Mushrooms

Learning Outcomes

The students:

1) compare mushrooms with plants and vertebrates;
2) describe the structural and functional diversity of mushrooms and give examples of this;
3) explain the means of reproduction of mushrooms and lichen and the conditions necessary for their development;
4) analyse the role of parasitism and symbiosis in nature;
5) explain the interaction between mushrooms that form lichen and algae;
6) explain why lichen can grow in places where plants do not grow;
7) analyse the role of mushrooms and lichen in nature and human activities and give examples of this; and
8) value mushrooms and lichen as important parts of wildlife.

Learning Content

Comparison of the external structure and main functions of mushrooms with plants and animals. The diversity of the external structure of mushrooms in the example of the most common *Ascomycota* and *Cortinarius* mushroom. Reproduction of mushrooms by spores and proliferation. Eating dead and live organisms, parasitism and symbiosis. Means of distribution of spores and the necessary conditions for

germination. The necessary conditions for fermentation. Fungus disease infection of humans and plants and how to prevent it.
Lichen as a form of cohabitation of mushrooms and algae. Diversity of lichen, their different forms of growth and locations of growth. Characteristics of lichen nutrition, primary settlement of new areas of growth. The role of mushrooms and lichen in nature and human activities.
Concepts: single-celled organism, multi-celled organism, fermentation, proliferation, symbiosis, mycorrhiza
Practical work and use of ICT

1. Comparing external characteristics of mushrooms using examples or Internet-based study materials.
2. Studying the structure of mushrooms with a microscope.
3. Research to find the factors that influence the development of moulds and yeasts.
4. Doing practical work or using a computer model to assess air pollution on the basis of the distribution of lichen.

2.2.4.7. Features and Life Processes of Invertebrates

Learning Outcomes
The students:

1) compare the adaptation of different invertebrates in connections with their living environment;
2) analyse the role of different invertebrates in nature and human activities and give examples of this;
3) associate the structure of the organs of movement of invertebrates from different groups with the forms of movement and living areas characteristic of them;
4) analyse the connection between the level of development of the sense organs of representatives of different groups of invertebrates and their living areas and manners of eating;
5) analyse the advantages of anisogamy and isogamy of invertebrates from different groups;
6) assess the advantages of direct development, complete and incomplete metamorphosis and give examples of these;
7) explain the importance of changing the host organism, food object and/or living area during the Learning of development of parasitic organisms; and
8) value invertebrates as an important part of wildlife.

Learning Content
General description of invertebrates and comparison with vertebrates. The main external characteristics of sponges, coelenterates, worms, molluscs, arthropods and echinoderms, their distribution and importance in nature and human life. Comparison of external characteristics of arthropods (crustaceans, araneids and insects). The differences in the external characteristics of common groups of insects and molluscs.
Adaptations for breathing and eating of invertebrates who spread freely and are parasitic. The breathing of invertebrates through gills, lungs and trachea. Different means and organs for obtaining food in invertebrates.
Isogamy and anisogamy of worms, molluscs and arthropods. The changing of host organism and intermediate host organism in the development of worms. The specificities of reproduction and development of animals with direct development and complete and incomplete metamorphosis.
Concepts: trachea, simple eye, compound eye, mouthparts, tentacle, isogamy, complete and incomplete metamorphosis, larva, parasitism, host, intermediate host
Practical work and use of ICT

1. Comparing the external characteristics of invertebrates using examples or Internet-based study materials.
2. Comparing the external characteristics of arthropods with a magnifying glass or microscope.

3. Practical work or using a computer model to assess the pollution in the environment on the basis of the spread of invertebrates.

2.2.4.8. Structure and Living Processes of Microorganisms

Learning Outcomes

The students:

1) compare the structure of bacteria and protozoa with animals and plants and the structural specificities of viruses with cellular structure;
2) explain the distribution of bacteria and protozoa in different living areas, including aerobic and anaerobic environments;
3) analyse and explain the importance of bacteria and protozoa in nature and human activities;
4) explain ways of protecting food from microbial spoilage;
5) assess the importance of fast reproduction and formation of stable spores in the spread of bacteria;
6) know how to prevent the most common human bacterial and viral diseases and value healthy lifestyles;
7) explain professions related to microorganisms; and
8) value the importance of bacteria in nature and in human life.

Learning Content

Comparing the main features of bacteria and protozoa with animals and plants. The distribution and importance of microorganisms that spread freely and are parasitic. Aerobic and anaerobic bacteria and parasitism. Necessary conditions for fermentation. The reproduction and spread of bacteria. Becoming infected with bacterial diseases and disease prevention. The role of bacteria in nature and human activities. The structural and functional specificities of viruses. Becoming infected by viruses, latent period, falling ill and recovering.

Professions connected to microorganisms.

Concepts: bacteria, protozoa, virus, pulsating vacuole, halving, aerobic bacteria, anaerobic bacteria

Practical work and use of ICT

1. Assessing the spread of bacteria by growing a bacteria culture.
2. Studying the factors influencing the vital functions of bacteria on a computer model.

2.2.4.9. Ecology and Environmental Protection

Learning Outcomes

The students:

1) explain the structure of populations, species, ecosystems and biospheres and give examples of these;
2) explain how natural balance is formed in ecosystems and assess the positive and negative effects of human activities on the changing of populations and ecosystems and ways of solving environmental problems;
3) analyse the effect of ecological factors on the abundance of organisms on the basis of information given in diagrams and tables;
4) assess the importance of competition within species and between species in the example of animals and plants;
5) solve biomass pyramid tasks;
6) solve dilemma problems connected to the protection of biodiversity; and
7) value biodiversity and have a responsible and sustainable attitude towards different ecosystems and living areas.

Learning Content

Division of organisms into species. Structure of populations, ecosystems and biospheres. Natural balance. Factors of inanimate and animate life (ecological factors) and their effect on different groups of organisms. The formation of the growth of the biomass pyramid and determining the abundance of links in a food chain.

Human effect on populations and ecosystems. Importance of biodiversity. Protection of species and living areas in Estonia. Human activities in solving environmental problems.

Concepts: species, population, habitat, ecosystem, community, factors of inanimate nature, factors of wildlife, biogeochemical cycle, competition, natural balance, environmental protection, nature protection, biodiversity, biosphere

Practical work and use of ICT

1. Practical study of the dependence of the abundance of populations on ecological factors.
2. Finding connections on a computer model between the abundance of links in a food chain and growth in biomass.
3. Solving biomass pyramid tasks.
4. Studying the change of patterns in natural balance on a computer model.

2.2.4.10. Human Organ Systems

Learning Outcomes

The students:

1) associate human organ systems with their main tasks;
2) explain the tasks of skin;
3) analyse the accordance of the structure and function of skin when fulfilling tactile, protective, thermoregulatory and excreting functions; and
4) value healthy lifestyles connected to skin.

Learning Content

The main tasks of human organ systems. Skin structure and tasks in exchange of information with the outer environment.

Concepts: musculoskeletal system, digestive system, nervous system, circulatory system, respiratory system, excretory system, genital system, skin

2.2.4.11. Bones and Muscles

Learning Outcomes

The students:

1) differentiate, in a drawing or model, the main bones and muscles of the human skeleton;
2) compare the skeletons of mammals, birds, amphibians, reptiles and fish;
3) associate the structure and function of bones and muscles;
4) explain the types of connections between bones and give examples of these;
5) compare the structure and function of smooth muscle, striated muscle and cardiac muscle;
6) explain the nature of bone fractures, muscle strains and muscle tears and their causes;
7) analyse the effect of exercising on the musculoskeletal system; and
8) consider healthy exercise important.

Learning Content

The role of bones and muscles in the musculoskeletal system of humans and other vertebrates. The structural specificities of bones. The types and importance of connections between bones. Comparison of the human skeleton with that of other vertebrates.

Accordance between the structure and function of muscles. The microscopic structure of bones and bone tissue and its connection with function. The effect of exercise on the musculoskeletal system. The nature and causes of bone fractures, muscle strains and muscle tears.

Concepts: skeleton, bone, muscle, joint

Practical work and use of ICT

1. Comparing the structure of animal tissue under a microscope.
2. Research work on the connection between muscle exhaustion and exercise.

2.2.4.12. Circulatory System

Learning Outcomes

The students:

1) analyse drawings and schemes of the human circulatory system and explain the functions of the system on the basis of these;
2) associate the structural specificities of different blood vessels and components of blood with their functions;
3) explain the changes in the vital functions of cells caused by viruses and the role of the immune system in blocking bacterial and viral illnesses and in recovering from them;
4) value healthy lifestyles, which include prevention against infection with HIV;
5) explain the effect of exercise on the circulatory system;
6) associate the most common human cardiovascular diseases with their causes including smoking and unhealthy diet; and
7) value lifestyles that strengthen and sustain the heart, circulatory system and immune system.

Learning Content

The role of the heart and systemic and pulmonary circulation in the human metabolism and energy transformation. The distinct nature of the circulatory system of humans and other mammals in comparison with other vertebrates. The structural and functional connection between different blood vessels. The tasks of blood components.

The role of blood in the immune system of an organism. The formation of the immune system: short- and long-term immunity. The role of the immune system and vaccination in the prevention of bacterial and viral diseases. Disturbances in the immune system, allergies and AIDS.

The effect of exercise on the circulatory system. Effects of myocardial under- or overload. Causes and effects of the thickening of the inner walls of arteries and high/low blood pressure.

Concepts: heart, blood vessel, artery, vein, capillary, arterial blood, venous blood, blood pressure, electrocardiogram, haemoglobin, red blood cell, white blood cell, blood platelet, blood plasma, coagulation, lymph, lymphatic gland, antibody, immunity, immune system, HIV, AIDS

Practical work and use of ICT

Research about the effect of physical load on the pulse or blood pressure.

2.2.4.13. Digestion and Excretion

Learning Outcomes

The students:

1) compile and analyse drawings and schemes of the structure of the gastrointestinal system and explain, on the basis of these, the digestion of food and absorption of nutrients;
2) explain the tasks of proteins, fats, carbohydrates, vitamins, mineral products and water in the human organism and the problems caused by over- or under-consumption;
3) assess the role of the kidneys, lungs, skin and bowels in the excretion of waste products; and

4) follow principles of healthy eating.

Learning Content

The structure and function of the human gastrointestinal system. The factors that affect the need for energy in the body. Healthy eating and causes and effects of being overweight and underweight. The general working principles of the kidneys in ensuring the stable composition of the blood. The task of excretion of the lungs, skin and bowels.

Concepts: enzyme, vitamin, saliva, liver, bile, small intestine, large intestine, kidney, urine

Practical work and use of ICT

1. Studying factors that affect our need for energy using practical work or a computer model
2. Analysis of personal eating habits

2.2.4.14. Breathing

Learning Outcomes

The students:

1) analyse the accordance between the structure and function of the respiratory system;
2) compile and analyse drawings and schemes of the structure of the respiratory system and the composition of the air inhaled and exhaled and explain the nature of breathing on the basis of these;
3) analyse the effect of exercise on the respiratory system;
4) explain the main causes of the most common illnesses of the respiratory organs and ways of preventing these illnesses; and
5) have a responsible attitude towards the health of their respiratory system.

Learning Content

The connection between the structure and function of the respiratory system. Comparison of the composition of air inhaled and exhaled. The task of oxygen in cells. The factors that determine the oxygen need of the body and the regulation of breathing. The effect of exercise on the respiratory system. The most common illnesses of the respiratory system and prevention of them.

Concepts: trachea, bronchi, alveoli, respiratory centre, cell breathing

Practical work and use of ICT

Practical work or studying on a computer model the connections between lung volume, depth and frequency of breathing and the amount of oxygen acquired.

2.2.4.15. Reproduction and Development

Learning Outcomes

The students:

1) compare the structure and function of the male and female sex organs;
2) compare the structure and development of human egg cells and sperm;
3) explain the means of spreading of the most common venereal diseases and ways of avoiding getting sick;
4) analyse the factors that effect the fertilisation of egg cells;
5) solve dilemma problems connected to family planning;
6) explain the changes in the development of a human foetus;
7) associate age-specific anatomical changes in the body with functional changes; and
8) value a sexual life that sustains themselves and others.

Learning Content

Comparison of the structure and function of the male and female sexual organs. Maturation of egg cells and sperm. Health of sex organs, spread of venereal diseases and ways of avoiding getting sick. Fertilisation of egg cell, foetal development, Learning of pregnancy and giving birth. Family planning and risks related to abortion. The functional changes of the human body from birth to death.
Concepts: uterus, ovary, testes, testicle, ovulation, sperm, foetus, placenta, umbilical cord, giving birth, clinical death, biological death

2.2.4.16. Regulation of Functions

Learning Outcomes

The students:

1) explain the main functions of the central nervous system and peripheral nervous system;
2) associate the structure of the nerve cell with its function;
3) compile and analyse the schemes of the reflex arc and, based on this, explain its function;
4) associate different endocrine glands with the hormones they produce;
5) describe the tasks of hormones and give examples of them;
6) explain the role of the nervous system and hormones in the regulation of the functions of organ systems; and
7) take a critical attitude towards the abuse of substances that damage the nervous system.

Learning Content

The structure and tasks of the central nervous system and peripheral nervous system. The structure of the nerve cell and the tasks of different parts of the cell. The structure and function of the reflex arc. Health of the nervous system.
The tasks of the hormones produced by the main endocrine glands.
Cooperation between organ systems to ensure the integrity of the human body. The role of the nerve system and hormones in the regulation of the functions of organ systems.
Concepts: brain, spinal cord, nerve, nerve cell, receptor, nerve impulse, dendrite, neuritis, reflex, endocrine glands, hormones

Practical work and use of ICT

1. Research to establish the factors influencing reaction speed and comparing the reaction speeds of students.
2. Studying the work of the reflex arc on a computer model.

2.2.4.17. Exchange of Information with the Outer Environment

Learning Outcomes

The students:

1) analyse the cooperation between the parts of the eye and the centre for vision of the cerebrum in the creation and interpretation of vision;
2) explain the reasons for the occurrence of short- and long-sightedness and ways of preventing and correcting visual disorders;
3) associate the structure of the ear with the senses of hearing and balance;
4) compare and associate the structure and function of the organs connected to the senses of smell and taste; and
5) value lifestyles that sustain the sense organs.

Learning Content

Connection between eye structure and function. Prevention and correction of visual disorders. The connection between the structure of the ears and our sense of hearing and balance. Prevention and

correction of hearing disorders. Connection between the structure and function of the organs connected to the senses of smell and tasting.

Concepts: pupil, lens, retina, iris, yellow spot, rod cells, cone cells, short-sightedness, long-sightedness, external ear, middle ear, internal ear, ear lobe, ear drum, ear bones, middle ear, cochlea, semicircular canals.

Practical work and use of ICT

1. Research to establish the sensitivity of the sense organs.
2. Studying the occurrence of visual sense and hearing on a computer model.

2.2.4.18. Heredity and Changeability

Learning Outcomes

The students:

1) analyse the role of heredity and changeability in the example of human features;
2) explain the connection between DNA, genes and chromosomes and their role in heredity and the inheritance and expression of genes;
3) solve simple genetics tasks related to the expression of dominant and recessive gene alleles;
4) assess the role of hereditary and non-hereditary changeability in the example of human features and analyse information about the extent of changeability presented in diagrams and tables;
5) assess the possibilities of genetic change of organisms, relying on scientific and other important viewpoints;
6) analyse the possibilities of prevention of hereditary diseases and diseases with hereditary predispositions;
7) describe the areas of activity of gene technology and the professions related to this; and
8) take an understanding attitude towards the hereditary and non-hereditary diversity of humans.

Learning Content

Heredity and changeability in the formation of the features of organisms. The role of DNA, genes and chromosomes in heredity. Inheritance of genes and the expression of the features determined by them. Solving simple genetics tasks. Importance of the changeability of heredity.

Reasons for and importance of the occurrence of non-hereditary changeability. The possibilities of changing the heredity of organisms and the scientific and ethical questions they raise. Comparison of hereditary diseases and diseases with hereditary predisposition and prevention of getting sick. The field of activity of gene technology and the professions related to it.

Concepts: hereditary changeability, non-hereditary changeability, mutation, chromosome, DNA, gene, dominance, recessiveness, gene technology

Practical work and use of ICT

1. Studying the expression of patterns of heredity and mechanisms of occurrence on a computer model.
2. Research paper about the extent of non-hereditary changeability on the basis of features of a freely chosen organism.

2.2.4.19. Evolution

Learning Outcomes

The students:

1) explain the nature of biological evolution and give examples of this;
2) give examples of proof of evolution;
3) associate the survival of the fittest with natural selection;
4) analyse the general Learning of the formation of species and their changing;

5) assess the role of the biggest evolutionary changes in diversifying and distributing organisms;
6) compare the evolution of humans and other vertebrates; and
7) associate the perspectives of evolutionary theory with the development of natural sciences.

Learning Content

Nature of biological evolution, main directions and proof. The development of natural selection as the result of the survival of the fittest. The formation and changing of species. The importance of adaptation of organisms in evolution. The most important stages of evolution. The specificity of human evolution.

Concepts: evolution, natural selection, survival of the fittest, adaptation, crossing barrier, fossil

Practical work and use of ICT

Studying the factors of evolution on a computer model.

2.3. Geography

2.3.1. Learning and Educational Objectives

The objective of learning Geography in basic school is that by the end of basic school the student would:

1) show an interest in Geography and other natural and social sciences and understand the importance of these in everyday life and development of society;
2) have an overview of the phenomena and processes taking place in nature and society, their spatial location and connections;
3) value the natural and cultural diversity of their home area, Estonia and other countries;
4) understand the dependence of human activities on the limited resources of the Earth and the effects of human activities on the environment, have a responsible attitude towards the environment and follow the principles of sustainable development;
5) apply scientific method to solving problems, plan and carry out research work, observations and measurements and interpret and present the results obtained;
6) use sources of information and critically assess the geography-related information they contain and read and make sense of simple science texts;
7) have an overview of geography-related professions and understand the necessity of geography-related knowledge and skills for different areas of work; and
8) understand the importance of scientific and technology literacy and be creative and motivated for lifelong learning.

2.3.2. Subject description

Geography is an integrated subject which belongs to both the natural science (Natural Geography) and social sciences (Human Geography). The students rely on the knowledge, skills and attitudes acquired in Science, and integrate Mathematics, Physics, Biology, Chemistry, History and Civic Studies. In studying Geography, the students develop scientific and technology literacy, the students acquire an understanding of the Earth as a whole and the mutual effects between the environment and human activities. An important role is played by skills of solving problems and making justified decisions. The knowledge, skills and attitudes acquired in Geography and other natural and social sciences form the basis for internally motivated lifelong learning.

The main aim of basic school Geography is for students to gain an overview of the phenomena and processes taking place in nature and society and their spatial distribution and connections by studying certain areas as examples. The emphasis is on the importance of preserving natural and cultural diversity and the need to research this. The students acquire an understanding of science as a process which

creates knowledge and provides explanations about their surroundings. At the same time, the students' inquiry and problem-solving skills are developed.

In studying Geography, it is important to develop an understanding of the connections between humans and the environment, the limited nature of natural resources and the need to use them rationally. The students' environmental awareness is developed: they adopt a sustainable lifestyle and gain an idea of sustainable development, plus attitudes that value the environment, which is looked at in its widest meaning, including the natural, economic, social and cultural environment.

Geography plays an important role in shaping the students' values and attitudes. Approaches to world nature, population and cultural geography form a basis for an understanding and tolerant attitude towards the cultures and traditions of other countries and peoples. Studying Estonian Geography forms a basis for valuing the nature, history and cultural heritage of the students' homeland.

In order to cope in the fierce competition of a globalising world, people need to know different areas of the world – their economies, cultures and traditions – better, primarily for studying, working and recreation. Studying Geography helps to shape the self-definition of students as active citizens of Estonia, Europe and the world.

In studying Geography, the students acquire skills in map-reading and use information technology, the need for which is growing in today's mobile society.

The material studied is presented in a problem-based way as much as possible and in connection with the students' everyday lives and home areas. In the studies, the individual specificities of the students are taken into account and their abilities are developed from diverse perspectives. Significant attention is paid to shaping the studying motivation of students, and in order to achieve this various interactive study methods are used: problem-based and research-based studying, project work, discussions, brainstorming, role plays, studies outside of the classroom, study visits etc. At all stages of study, technological instruments and information and communication technology are used.

With research-based study the students learn how to formulate problems and hypotheses, plan work, carry out observations, measure and process, interpret and present results. An important role is played by the skill of using different sources of information (including the Internet) and critically assessing the information they find there.

2.3.3. Learning and Educational Outcomes in the 3rd Stage of Study

After completing the 9th grade, students:

1) are interested in the phenomena and processes taking place in nature and society and understand the importance of natural and social sciences in the development of society;
2) have acquired an overview of the most importance phenomena and processes taking place in nature and society and understand their spatial location and connections;
3) have a responsible attitude towards the living environment, valuing the nature and culture of their home area, Estonia and other countries and principles of sustainable development;
4) use geography-related knowledge and scientific methods to solve problems;
5) use sources of information to find geography-related information, analyse, synthesise and assess the information contained in them critically and apply this in explaining processes taking place in nature and society, describing phenomena and objects and solving problems; and
6) have acquired an overview of geography-related professions, value the knowledge and skills they have acquired when planning their careers and are motivated for lifelong learning.

2.3.4. Learning Outcomes and Learning Content in the 3rd Stage of Study

2.3.4.1. Study of Maps

Learning Outcomes

The students:

1) can find the necessary maps from an encyclopaedia or the Internet and use the list of place names in an atlas;
2) identify directions according to the geographic coordinate system on a map and with the help of a compass in the natural environment;
3) measure distances using different scales on a map and steps in the natural environment;
4) identify the geographic coordinates of a given place and find a location according to coordinates;
5) identify time in different parts of the world according to a time zone map;
6) compile a simple plan of a given place; and
7) use printed maps and digimaps, tables, graphs, diagrams, drawings, pictures and texts in order to find information, describe processes and phenomena, find connections between then and draw conclusions.

Learning Content

Shape and size of the Earth. Diversity and function of maps. General geographic and thematic maps, including world map and European political map. Printed and computer maps, including interactive maps. Scale and measuring distances in nature and on a map. Identifying distances in nature and on a map. Location and identifying location. Geographic coordinates. Time zones.

Concepts: plan, map, general geographic and thematic map, computer map, interactive map, satellite photo, aerial photo, azimuth, symbols, scale, large and small scale maps, map generalisation, pole, parallel, equator, meridian, prime meridian, parallel of latitude, meridian of longitude, geographic coordinates, geographic coordinate system, time zone, world time, zone time, local sunrise and sunset times, International Date Line

Practical work and use of ICT

1. Using an interactive map to find information (measuring distances, searching according to an address, identifying coordinates and finding and marking objects).

2.3.4.2. Geology

Learning Outcomes

The students:

1) describe, according to drawings, the internal structure of the Earth and give examples of ways of studying it;
2) describe tectonic plates according to drawings and maps as well as the geological processes taking place on the edges of tectonic plates: volcanism, earthquakes and the formation and transformation of landforms and rocks;
3) know the reasons for the occurrence of earthquakes and volcanic eruptions, show on a map the main areas where they occur, give examples of their consequences and know how to act in the case of danger;
4) give examples of the lives and economic activities of people in seismic and volcanic areas;
5) explain the erosion of rocks, movement and sedimentation of erosion-related material and formation of sedimentary and igneous rocks;

6) describe (and recognise in nature and pictures) sand, gravel, clay, moraine, granite, sandstone, limestone, oil shale and coal and give examples of their use; and
7) understand the necessity of geological research and have an overview of the work of geologists.

Learning Content

Internal structure of the Earth. Tectonic plates and their movement. Earthquakes. Volcanic activity. People's lives and economic activities in seismic and volcanic areas. Rocks and their formation.

Concepts: Earth's crust, mantle, continental and oceanic crust, tectonic plate, orogeny, magma, volcano, magma chamber, volcanic vent, crater, lava, active and inactive volcanoes, thermal spring, geyser, earthquake, fault, seismic waves, epicentre, focus, tsunami, erosion, erosion-related material, sediment, sedimentary rock, igneous rock, outcrop, fossil

Practical work and use of ICT

1. Describing and comparing rocks (sandstone, limestone, oil shale, coal and granite) and sediments (sand, gravel and clay).
2. Compiling an overview or presentation on the basis of sources of information of one geological phenomena (earthquake or volcano) or describing an area from a geological angle.

2.3.4.3. Landforms

Learning Outcomes

The students:

1) have acquired an overview of the world's flat and mountainous areas and name and find on a map mountain ranges, highlands, highest points and flatlands (tablelands, flatlands, low plains and lowlands);
2) describe landforms and groups of landforms according to a large-scale map;
3) describe landforms and groups of landforms in a given location according to pictures, drawings and maps;
4) describe the relief of ocean floors according to drawings and maps and associate the location of a mid-ocean ridge and abyss with the movement of tectonic plates;
5) give examples of the transformation of landforms and groups of landforms due to different factors (erosion, wind, water and human activities); and
6) give examples on the lives and economic activities of humans in flat and mountainous areas, risks of moving around in mountains and ways of avoiding these risks.

Learning Content

Landforms and groups of landforms. Depiction of landforms on maps. Mountain ranges and highlands. Life and economic activities of humans in mountainous areas. Flat land. Life and economic activities of humans in flat areas. The relief of the Earth's ocean floors. The transformation of landforms and groups of landforms over time.

Concepts: groups of landform or reliefs, contour line or horizontal, absolute altitude, relative altitude, profile line, landform, hill, chain of mountains, mountain range, highland, flatland, tableland, low plain, lowland, continental shelf, continental slope, mid-ocean ridge, abyss, erosion, gorge

Practical work and use of ICT

Compiling a description of a landform and groups of landform in an area on the basis of maps and other sources of information.

2.3.4.4. Population

Learning Outcomes

The students:

1) describe the geographic location of a given country;
2) name and show the biggest countries and cities on a world map;
3) give examples of the cultural diversity of nations and value the languages and traditions of different nations;
4) find on a map and name the most densely and most sparsely populated areas and describe the location of the population of a given country;
5) describe changes in the size of the population of the world or one area according to a map and drawings; and
6) describe urbanisation and give examples of the reasons for and problems associated with urbanisation.

Learning Content

Countries on the world map. Different races and ethnicities. Location and density of population. Size of world population and its changes. Urbanisation.

Concepts: country, political map, geographic location, population, race, population density, urbanisation, conurbation

Practical work and use of ICT

Finding general data and symbols of a country and describing its geographic location and location of population according to maps and other sources of information.

2.3.4.5. Climate

Learning Outcomes

The students:

1) know the indicators used to describe the weather and climate;
2) find information about weather conditions in Estonia and elsewhere in the world and draw practical conclusions from this in planning activities and clothing;
3) explain the distribution of solar radiation on Earth and know the reasons for the changing of the seasons;
4) describe general air circulation according to a drawing;
5) explain the effect of oceans, seas and landforms on the climate;
6) identify major climate zones and sub-climates and produce a typical climate diagram for a corresponding climate zone;
7) describe and compare the climates of given places on the basis of thematic maps and climate diagrams and explain the reasons for differences in climate; and
8) give examples of the effect of weather and climate on human activities.

Learning Content

Weather and climate. Climate diagrams and climate maps. Factors that shape the climate. The distribution of solar radiation on Earth. The formation of seasons. The connection between temperature and barometric pressure. General air circulation. The effect of oceans, seas and landforms on the climate. Climate zones. The effects of weather and climate on human activities.

Concepts: weather, climate, weather map, climate map, climate diagram, monthly and yearly average temperatures, solar radiation, air mass, easterlies, continental and sea climate, breezes, snowline, windward and leeward slope, climate zone

Practical work and use of ICT

1. Finding a weather data from the Internet and describing the weather in a given place.
2. Comparing climates in two given areas according to weather maps and diagrams and explaining the differences between them.

2.3.4.6. Bodies of Water

Learning Outcomes

The students:

1) associate the abundance of water in a given area and changes in water levels with the climate;
2) describe and compare seas, including the Baltic Sea, on the basis of sources of information and highlight the reasons for these differences;
3) describe and compare rivers on the basis of drawings, photos (including satellite photos) and maps as well as the eroding, transmissive and accumulative activities of water in different sections;
4) explain the changes in water level in rivers on the basis of sources of information, including climate diagrams;
5) describe rivers and reservoirs and their use on the basis of sources of information; and
6) describe the water cycle, explain the importance of water and bodies of water in nature and human activities and give examples of the necessity of use and need to protect water.

Learning Content

Distribution of water resources on the planet. Water cycle. The Earth's oceans and parts thereof. Temperature, saltiness and ice conditions in different parts of the Earth's oceans. Mountain and plain rivers and the effect of flowing water on the formation of landforms. Water regime of rivers and floods. Lakes and reservoirs. Use and protection of bodies of water.

Concepts: water cycle, the Earth's oceans, ocean, bay, strait, inland sea, dependent sea, saltiness of water, river slope, flow rate, rhithron zone and potamon zone, old river, dale, barranca, valley flat and canyon valley, delta, high water, low water, flood, salt lake

Practical work and use of ICT

1. Studying the eroding and accumulative activities of flowing water of a given river in different sections according to drawings, photos (including satellite photos) and maps.
2. Compiling an overview of a given sea according to sources of information.

2.3.4.7. Geographical Zones

Learning Outcomes

The students:

1) recognise geographical zones in drawings and pictures and describe their location according to a map;
2) describe the climate of geographical zones, their bodies of water, conditions of soil formation, typical plants and animals and analyse their connections;
3) recognise the typical climate diagrams of geographical zones (and in drawings and pictures) and their landscapes, plants, animals and soils;
4) explain high altitude and compare high altitude in different mountain ranges;
5) explain the causes of glaciers and describe their location and importance;
6) give examples of the interaction of nature and human activities in different geographical zones and mountain ranges; and
7) describe and compare given areas on the basis of sources of information – their geographic location, groups of landforms, climate, bodies of water, soil, flora, land use, natural resources, population, settlement, road network and economy – and analyse the connections between these aspects.

Learning Content

Connections between different components of nature (climate, soil, flora, fauna and groups of landforms). Geographical zones and the patterns of their location. Ice belt. Tundra. Temperate zone coniferous forest and greenwoods. Temperate zone grassland. Mediterranean shrub and forest. Desert. Savannah. Equatorial rainforest. High altitude in different mountain ranges. Human activities and environmental problems in different geographical zone and mountain ranges.

Concepts: geographical zone, tropics of Cancer and Capricorn, zenith, Arctic and Antarctic circles, polar day and night, permafrost, taiga, steppe, prairie, oasis, desertification, podsol, black soil and red soil, erosion, biodiversity, indigenous people, high altitude, high mountains, forest line, continental glacier and mountain glacier, Arctic, Antarctic

Practical work and use of ICT

1. Compiling a description of a given area on the basis of sources of information and analysing the connections between natural components and human activities and environmental problems.
2. Compiling a concept map for one geographical zone.

2.3.4.8. European and Estonian Geographic Location, Landforms and Geology

Learning Outcomes

The students:

1) describe the geographic location of a given European country, including Estonia;
2) describe and compare on a map the landforms and groups of landforms of a given area, including Estonia;
3) associate Europe's largest landforms with their geological structure;
4) describe Estonia's geological structure according to drawings, thematic maps and the geochronological scale;
5) describe the location of national resources in Europe, including Estonia, according to maps;
6) describe the activity of continental glaciers in shaping the landforms in Europe, including Estonia; and
7) identify, with the aid of relief maps ,mountain ranges, highlands, higher points and plains: flatlands, plateaus, low plains and lowlands.

Learning Content

Location, size and borders of Europe and Estonia. European groups of landforms. The connection between groups of landforms and geological structure. Estonian groups of landforms. Estonian geological structure and natural resources. The activity of continental glaciers in shaping landforms in Europe, including Estonia.

Concepts: natural geographic and economic geographic location, Estonian main map, landscape, high and low mountains, flatlands, fold mountains, young and old mountains, platform, shield, geochronological scale, highland, low plain, plateau, bedrock, surfacing, continental glacier, moraine, moraine hill, terminal moraine, moraine plain

Practical work and use of ICT

1. Comparing the geographic location of Estonia and other European countries.
2. Compiling an overview of the groups of landforms in the student's home county on the basis of sources of information and associate them with geological structure.

2.3.4.9. European and Estonian Climate

Learning Outcomes

The students:

1) describe the regional climatic differences in Europe, including Estonia, and explain the effect of the factors shaping the climate on the climate of a given place;
2) describe the weather in a given place according to a weather map (barometric pressure, areas of high or low pressure, warm or cold fronts, precipitation and winds);
3) understand the importance of studying climate change and give examples of contemporary ways of studying it; and
4) give examples of the possible consequences of climate change.

Learning Content

Factors that shape the European (including Estonian) climate. Regional climate differences in Europe. The Estonian climate. The European weather map. Possible consequences of climate change in Europe.

Concepts: isotherm, barometric pressure, current, western winds, area of high/low pressure, warm and cold front, cyclone, anticyclone

Practical work and use of ICT

Comparing weather in given situations according to data from the Internet and explaining the reasons for the differences.

2.3.4.10. European and Estonian Bodies of Water

Learning Outcomes

The students:

1) describe the specificity and environmental problems of the Baltic Sea and give examples of ways of solving them;
2) describe and compare different parts of the coastline of the Baltic sea: glint, islet coast and skerry coast;
3) explain the formation and movement of groundwater, use of groundwater in their home area and groundwater-related problems in Estonia;
4) know about the distribution of bogs in Europe, including Estonia, and explain the ecological and economic importance of bogs; and
5) describe the coastline and bodies of water in Europe (including Estonia) and name and show the most important bays, straits, islands, peninsulas, lakes and rivers on European and Estonian maps.

Learning Content

Specificities of the Baltic Sea and the reasons for this. The Baltic Sea as a transboundary water body, its economic use and environmental problems. Different kinds of coasts of the Baltic Sea. Formation and movement of groundwater. Problems with groundwater in Estonia. Bogs in Europe, including Estonia.

Concepts: catchment area, watershed, brackish water, glint, islet coast, skerry coast, dune, spit, coastal landform, groundwater, saturated and unsaturated layers, level of groundwater, permeable and water-bearing rocks and silt.

Practical work and use of ICT

Studying the groundwater of the student's home area and its properties and use.

2.3.4.11. European and Estonian Population

Learning Outcomes

The students:

1) find information from different sources about the populations of different countries and give examples of studying populations and their importance;

2) analyse, according to sources of information, the size of populations in Europe (including Estonia) or another region and changes therein;
3) describe and analyse, according to sources of information (including population pyramids), the population of a given country (including Estonia) and the changes in population;
4) give examples of problems connected to the aging population in Europe (including Estonia) and of possible solutions to these problems;
5) explain the reasons for migration, giving specific examples from Estonia and elsewhere in Europe; and
6) describe the ethnic composition of Estonia and give examples of cultural diversity in Europe.

Learning Content

Size of the population in Europe (including Estonia) and changes therein. Differences in birth and death rates and natural growth in European countries. Sex and age composition of populations and problems of the aging population. Migration and the reasons for migration. Estonian national composition and its formation. Ethnic diversity in Europe.

Concepts: census, population register, birth rate, death rate, natural growth, population pyramid, aging, migration, immigration, emigration, voluntary migration, forced migration, refugee, ethnic composition

Practical work and use of ICT

1. Analysing the population of one's county or home area according to sources of information.
2. Analysing sex and age composition of a given country in Europe according to population pyramid.

2.3.4.12. European and Estonian Population

Learning Outcomes

The students:

1) analyse, according to a map, the location of population in Europe, including Estonia;
2) analyse the connections between the formation, location and development of cities in the example of Europe, including Estonia;
3) give reasons for urbanisation, give examples of problems connected to urbanisation in Europe, including Estonia, and of ways of solving these;
4) compare cities and rural settlements and analyse the differences between city and country life; and
5) identify and locate European countries and their capitals and the biggest towns in Estonia on a map.

Learning Content

Location of population in Europe. Cities and rural settlements. Reasons for urbanisation and urbanisation in Europe. Location of population in Estonia. Estonian settlements. Economic, social and environmental problems connected to urbanisation.

Concepts: urbanisation, conurbation, unplanned growth of cities

Practical work and use of ICT

Compiling a short study of the student's home area.

2.3.4.13. European and Estonian Economy

Learning Outcomes

The students:

1) analyse the effects of natural resources, workforce, capital and markets on the Estonian economy and give examples of the specialisation of the economy;
2) group economic activities according to primary sector, industry and service;

3) explain the importance of the energy sector and give examples of the effects of sources of energy and energy production on the environment;
4) analyse the advantages and disadvantages of using thermal and nuclear power plants, hydroelectric power stations and wind parks to produce electricity;
5) analyse, according to sources of information, the energy sector in Estonia and describe the use of oil shale to produce energy;
6) give examples of energy problems in Europe, including Estonia;
7) know ways of saving energy and value sustainable use of energy; and
8) give examples of the main European economic areas.

Learning Content

Economic resources. Structure of economy and new and old branches of industry. Sources of energy and the advantages and disadvantages of using them. European energy sector and energy problems. Estonian energy sector. Use of oil shale and environmental problems. Main European economic areas.

Concepts: economic maps, economic resources, renewable and non-renewable natural resources, capital, workforce, workforce quality, primary sector, industry, service, energy sector, sources of energy: thermal power, nuclear power, hydropower, wind power and solar power

Practical work and use of ICT

Analysing the use of energy sources in two European countries in producing electricity.

2.3.4.14. European and Estonian Agriculture and Food Industry

Learning Outcomes

The students:

1) give examples of branches of plant production and animal husbandry;
2) characterise the development potential of Estonian agriculture and gives reasons for specialisation;
3) describe soil as a resource;
4) give examples of different types of agricultural holdings in Europe, including Estonia;
5) give examples of the advantages of domestic food products and value Estonian products; and
6) give examples of environmental problems connected to agriculture and ways of solving them.

Learning Content

Natural factors that influence the development of agriculture. Different types of agricultural holdings and food industries in Europe. Estonian agriculture and food industry. Environmental problems connected to agriculture.

Concepts: plant production and animal husbandry, land use, area under cultivation, natural grassland, plant growth period, animal husbandry and plant production farms, plantations

Practical work and use of ICT

Studying the origin of food products and assessing the proportion of domestic and foreign goods by product group.

2.3.4.15. European and Estonian Service

Learning Outcomes

The students:

1) give examples of different services;
2) characterise and analyse the development potential and tourism industry of a given European country, including Estonia;
3) give examples of the positive and negative effects of tourism on the economic and social life as well as natural environment of a country or area;

4) analyse the advantages and disadvantages of types of transportation when carrying passengers and goods;
5) give examples of the main European transport corridors;
6) characterise and analyse the role of different types of transportation in the carriage of passengers and goods within Estonia according to sources of information; and
7) give examples of transport-related environmental problems and ways of solving them and value environmentally friendly use of transport.

Learning Content

Service and its distribution. Tourism as a rapidly developing branch of the economy. Types of tourism. The main tourism resources of Europe. Environmental problems that tourism produces. The Estonian tourism industry. Types of transport and their advantages and disadvantages when carrying passengers and different goods. The main European transport corridors. Estonian transportation.

Concepts: personal and business services, public and private sector services, tourism, transportation, transit operations

Practical work and use of ICT

1. Compiling an overview of the main attractions and potential for developing tourism in the student's town or country.
2. Compiling an itinerary and graph using sources of information

2.4. Physics

2.4.1. Learning and Educational Objectives of Physics

The objective of learning Physics in basic school is that by the end of basic school the student would:

1) show an interest in physics and other natural sciences and understand their importance in the development of everyday life and society;
2) acquire physics-related knowledge and process skills necessary for functioning in everyday life and lifelong learning;
3) know how to apply the scientific method when solving problems;
4) have an overview of the language of physics and know how to use it in simple cases;
5) develop the skill of reading and understanding science texts and learn how to find physics-related information in encyclopaedias and the Internet;
6) value the sustainable development of society and have a responsible attitude towards nature and society;
7) have acquired an overview of the connection of physics to instruments and technology and corresponding professions, value the knowledge and skills acquired at Physics lessons when planning their career ; and
8) develop scientific and technology literacy, creativity and system thinking and are motivated for lifelong learning.

2.4.2. Subject Description of Physics

Physics is a natural science and plays an important part in shaping the students' literacy in science- and technology-related issues. Physics explains natural phenomena, creates corresponding models and is closely connected to mathematics. Physics forms a basis for understanding instruments and technology and helps students to value technological professions.

The Physics Learning in basic school only studies a small proportion of physical phenomena and forms a basis from which to later develop a complete picture of physics as a natural science. In studying physics,

the students obtain a preliminary overview of the language of physics and learn to use it. The things studied are associated with everyday life, mathematical skills, instruments and technology and other natural sciences.

In studying physics, the main focus is on integrating natural sciensesscience (Physics, Chemistry, Biology and Geography) from two directions. Vertically, these subjects are integrated through common topics, such as development (evolution), interaction, movement (changing and transformation), systems and structures, energy, technology and the environment (society). Vertical integration is supported by the specificity of the area, taking into account the horizontal integration of the subjects.

The values of students are shaped by associating the solutions to problems with the general cultural/historic context. At the same time, the role of physicists in the history of science is studied as well as the meaning of physics and its applications for the development of humankind.

In the studying process the students develop skills that are needed for successful studies (of physics). Solving calculus-, graphics- or problem-based tasks and assessing how realistic the results are creates a basis for critical thinking. When learning about phenomena, experiments are preferred; when solving problems, scientific method are used.

The material studied is presented in a problem-based way as much as possible and in connection with the students' everyday lives. In the studies, the individual specificities of the students are taken into account and their abilities are developed from diverse perspectives. Significant attention is paid to shaping the studying motivation of students, and in order to achieve this various interactive study methods are used: problem-based and research-based studying, project work, discussions, brainstorming, role plays, study outside of the classroom, study visits etc. When planning studies, the teacher may change the order of the topics studied, wherein it is important to note that the changed order of topics follows the developmental specificities of the students and that the teaching takes place according to the principle of the growth of abstraction. When changing the order of themes, the students' motivation to study physics must be guaranteed (and this should, hopefully, see them achieve better results). At all stages of study, technological instruments and information and communication technology are used.

With research-based study the students learn how to formulate problems and hypotheses, plan work, carry out observations, measure and process, interpret and present results. An important role is played by oral and written presentation of research results, including verbal and visual forms of presentation. An important role is also played by the skill of using different sources of information (including the Internet) and critically assessing the information found there.

2.4.3. Learning and Educational Objectives of Physics in the 3rd Stage of Study

The objective of learning Physics in basic school is that by the end of basic school the student would:

1) use the concepts of physics, physical quantities, connections and applications in describing, explaining and predicting natural and technical phenomena;
2) solve situational, calculus and graphic tasks, the individual parts of the solutions of which contain connections with up to two formulas, and assess the validity of the results achieved;
3) convert measurement units using the following prefixes: mega-, kilo-, deci-, centi-, milli-, micro- and nano-;
4) formulate a research question or questions on the basis of a given description of a situation and conduct experiments, processes experiment data (table, arithmetic mean, evaluation of

indeterminacy of measurement and graphs) and draw conclusions about the validity of the hypotheses contained in the research question;
5) find physics-related information from handbooks and use this information when solving tasks;
6) produce drawings of physical objects, phenomena and applications;
7) solve complex tasks with applicable content that can be reduced to partial tasks;
8) recognise physics-related themes, problems and questions in different situations (natural science texts and personal experiences) and offer possible explanations for them; and
9) value the sustainable development of society and have a responsible attitude towards nature and society.

2.4.4. Learning Outcomes and Learning Content of Physics

Learning Outcomes and Learning Content

2.4.4.1. Study of Light

Light and Linear Spreading of Light

Learning Outcomes

The students:

1) explain the main properties of the sun as a source of light;
2) explain the important properties of the following concepts: source of light, types of light sources and spectrum of light;
3) know the meaning of the relation that light spreads in a linear way in an optically even environment.

Learning Content

Source of light. Light as spectral light. Sun. Star. Light as energy. The spectral structure of light. Linear spreading of light.

Reflection of Light

Learning Outcomes

The students:

1) know the important features of reflection and absorption of light, describe their relation to other phenomena and use them in practice;
2) name the important features of the following concepts: angle of incidence, angle of reflection and matt surface;
3) explain the law of reflection (i.e. in the reflection of light the angle of incidence is equal to the angle of reflection) and its meaning, describe the experiment that supports the validity of this relation and use this relation in practice; and
4) give examples of the uses of a flat mirror, non-flat mirror and concave mirror.

Learning Content

Law of reflection. Flat mirror, symmetry of an object and representation. Matt surface. The phenomenon of the reflection of light in nature and technology. Formation of the phases of the moon. Non-flat mirror and concave mirror.

Refraction of Light

Learning Outcomes

The students:

1) describe the important features of the refraction of light, explain their relation with other phenomena and use them in solving problems;

2) describe the important features of the following concepts: angle of refraction, focus, real representation and apparent representation;
3) explain the meaning of focal length and optical lens strength and ways of measuring them and know the measuring unit used;
4) explain the patterns of the refraction of light (i.e. when light is transmitted from one environment to another it refracts depending on the speed of light in substances either towards the perpendicular line of the surface or away from it) and explain the meaning of the formula $D = \frac{1}{f}$ and use this formula in solving problems;
5) describe the function of non-flat lens, concave lens, glasses and light filters and give examples of their use; and
6) conduct an experiment measuring the focal length of a non-flat lens or creating an enlarged or decreased representation of an object with a non-flat lens, know how to describe the representation created, construct a drawing of the experimental instrument to which they add the distances between the object, the lens and the screen and process the data of the experiment.

Learning Content

Refraction of light. Prism. Non-flat lens. Concave lens. Focal length of lens. Optical strength of lens. Eye. Magnifying glass. Short- and long-sightedness. Camera. The refraction of light in nature and technology. Colour of bodies. Absorption of light and light filter.

Concepts: star, full and half shadow, angle of incidence, refraction and reflection, matt surface, focus, lens, focal length, optical strength, real representation, apparent representation, glasses

Practical work and use of ICT

1. Studying lenses and representations.
2. Identifying the optical strength of lenses.
3. Studying full and half shadows.
4. Studying phenomena that confirm the refraction of light rays.
5. Studying colours and coloured light with light filters.

2.4.4.2. Mechanics

Movement and Force

Learning Outcomes

The students:

1) describe the important features of movement and its relation to other phenomena;
2) explain the meaning of longitude, volume, mass, area, density, speed, average speed and force as well as means of measurement and know the units of measurement used;
3) know the meaning of the formula $l = vt$ and use this formula in solving problems;
4) use movement graphs to describe movement;
5) know that, due to the interaction of relation, the speeds of bodies change less the bigger the mass of the body;
6) know the meaning of the formula $\rho = \frac{m}{V}$ and use it in solving problems;
7) explain the function of measuring instruments such as a ruler, gauge block, measuring cylinder and scales and their rules of use and use the measuring instruments in practice;

8) conduct an experiment measuring the mass and volume of the test body, process the experiment data, make the necessary calculations on the basis of the data and draw conclusions about the material of the text body on the basis of the data in the table;

9) know that when the forces influencing body balance each other out, the body is still or moves in a uniform and linear way ; know that when the forces that influence a body, the whole body is still or moves evenly in a linear way; and

10) know the balance of forces when the body moves evenly in a linear way.

Learning Content

Mass as a measure of the body's inertia. The density of a substance. Interaction of bodies. Force as a cause of increasing or decreasing the speed of movement. Point of application of the force that influences a body. The balance of forces and the movement of the body. Movement and force in nature and technology.

Interaction of Bodies

Learning Outcomes

The students:

1) describe the important features of the concepts of interaction, gravitation, friction and deformation, explain the relations of these with other phenomena and use these phenomena in solving problems;
2) explain the structure of the solar system;
3) name the important features of the concepts of gravity, frictional force and elasticity force;
4) know the meaning of the relation $F = m\,g$ and use this relation in solving problems;
5) explain the function and rules of the use of a dynamometer and use it to measure forces;
6) conduct an experiment measuring the gravity of test bodies and their frictional force when moving, drawing conclusions from this about the validity of the hypothesis included in the research question; and
7) give examples of forces in nature and technology and list their application.

Learning Content

Gravity. Solar system. Friction and frictional force. Elasticity and plasticity of bodies. Deformation and elastic force. Working principle of a dynamometer. Occurrence of interaction in nature and its application in technology.

Pressure in Nature and Technology

Learning Outcomes

The students:

1) name the important features of the phenomenon of swimming and its relations with other phenomena and explain its use in practice;
2) explain the meaning of pressure, name units of measurement and describe means of measurement;
3) describe the concepts of barometric pressure and vertical upward thrust;
4) formulate the relations that the pressure in liquids and gases is transmitted in all directions in the same way (Pascal's law) and in swimming and floating the vertical upward thrust is equal to the gravity influencing the body;
5) explain the meaning of the formulas $p = \frac{F}{S}$; $p = \rho\, g\, h$; $F_{ü} = \rho\, Vg$ and use them in solving problems;
6) explain the function and rules of use of a barometer; and

7) conduct an experiment measuring, in different experimental conditions, the vertical upward thrust influencing a body.

Learning Content

Pressure. Pascal's law. Manometer. Atmosphere of the Earth. Barometric pressure. Pressure in liquids at different depths. Vertical upward thrust. Swimming body and conditions for swimming and drowning. Aerometer. Pressure in nature and its applications in technology.

Mechanical Work and Energy

Learning Outcomes

The students:

1) explain the meaning of mechanical work, mechanical energy and capacity and means of identifying it and know the units of measurement used;
2) explain the following concepts: potential energy, kinetic energy and efficiency;
3) explain the relations that:
    a. the body can only do work when it has energy;
    b. completed work is equal to energy change;
    c. the mechanical energy of a body or system of bodies cannot be created or destroyed: it can only transform from one state to another (mechanical energy conservation law);
    d. all work done is always greater from useful work; and
    e. no simple mechanism gives an advantage in work (law of energy conservation in case of simple mechanisms);
4) explain the meanings of the formulas $A = F\ s$ and $N = \frac{A}{t}$ and use them in solving problems; and
5) explain the function, means of use and safety regulations of ingot, inclined plane, rotary and gear.

Learning Content

Work. Capacity. Energy, kinetic and potential energy. Law of conservation of mechanical energy. Simple mechanism and efficiency. Simple mechanisms in nature and their application in technology.

Oscillation and Wave

Learning Outcomes

The students:

1) describe the important features of the concepts of oscillation, sound and wave and their relations with other phenomena;
2) explain the meaning of oscillation period and oscillation frequency and means of measurement and know the units of measurement used;
3) name the important features of the following concepts: oscillation amplitude, sound intensity, sound wavelength and sound speed;
4) conduct an experiment measuring the dependence of a thread pendulum (spring pendulum) on the length of the pendulum, the mass of the test body and oscillation amplitude, process the experiment data and draw conclusions about the hypothesis contained in the research question.

Learning Content

Oscillation. Oscillation amplitude, period and frequency. Waves. Sound, sound speed, relation between oscillation frequency and sound wavelength and sound intensity. Vocal apparatus of living organisms. The ear and hearing. Noise and noise protection. Appearance of oscillation in nature and application in technology.

Concepts: density, speed, mass, force, gravity, gravitation, frictional force, elastic force, pressure, vertical upward thrust, mechanical work, capacity, potential energy, kinetic energy, efficiency factor, oscillation amplitude, oscillation frequency, oscillation period, sound wavelength

Practical work and use of ICT

1. Studying the material composition of bodies (identifying the density of known substances).
2. Studying the relation between gravity and frictional force and a dynamometer.
3. Studying vertical upward thrust.
4. Studying the oscillation of a pendulum.

2.4.4.3. Electricity

Electric Interaction

Learning Outcomes

The students:

1) explain the important features of the phenomena of electrifying bodies and electric interaction and explain their relations with other phenomena;
2) list the important features of the following concepts: electrified bodies, electric charge, elementary charge, electric charge of bodies and electric field;
3) explain the relations that like electrically charged bodies repel and unlike ones attract and the experiment that confirms the validity of these relations; and
4) conduct an experiment in order to study the electrifying of bodies and the effects between them and draw conclusions on the extent of electric interaction.

Learning Content

Electrifying bodies. Electric charge. Elementary charge. Electric field. Conductor. Isolator. Phenomena connected to charged bodies in nature and technology.

Electric Current

Learning Outcomes

The students:

1) list the important features of the following concepts: electric current, free current carriers, electric conductor and isolator;
2) name the important features of electric current in metal and electric current in solution containing ions and explain their relations with other phenomena and use in practice;
3) explain the meaning of the concept of intensity of a current, name the unit of measurement of the intensity of a current and explain the function and rules of use of an ammeter; and
4) explain the relations that a conductor warms up with the help of electric current, a conductor with electric current produces magnetic influence and electric current produces a chemical effect and explain their relations with other phenomena and use in practice.

Learning Content

Free current carriers. Electric current in metals and solutions that contain ions. The effects of electric current. Intensity of current. Electric current in nature and technology.

Circuit

Learning Outcomes

The students:

1) explain the meaning and means of measurement of the terms voltage, electrical resistance and resistivity and know the units of measurement used;
2) explain the important features of the concept of a circuit;
3) explain the relations that:
    a. the intensity of the current is proportional to voltage (Ohm's law) $I = \frac{U}{R}$;
    b. the conductors connected in a series have the same intensity as the current $I = I_1 = I_2 = ...$ and the total voltage of the chain is the sum of the voltage of the ends of single conductors $U = U_1 + U_2$;
    c. the ends of conductors connected in parallel have the same voltage $U = U_1 = U_2 = ...$ and the total intensity of the current of the chain is the sum of the intensities of the current passing through the single conductors $I = I_1 + I_2$;
    d. Resistance of conductor $R = \rho \frac{l}{S}$;
4) use previous relations in solving problems;
5) explain the function and rules of use of a voltmeter;
6) explain the function and safety regulations of resistors and give examples of the use of resistors;
7) explain the function and safety regulations of electrical appliances and give examples of the use of electrical appliances;
8) can find (in the case of series and parallel connection) voltage, intensity of current and resistance of the circuit; and
9) conduct an experiment directly measuring the intensity of the current and voltage, calculating resistance, processing experiment data and drawing conclusions about the relation between the intensity of the current and the voltage.

Learning Content

Electrical supply. Parts of a circuit. Voltage and voltmeter. Ohm's law. Electrical resistance. Resistivity. The dependence of the resistance of a conductor on the material and the measurements of the conductor. Resistor. Series and parallel connection of conductors. Examples of using series and parallel connection of conductors.

Work and Capacity of Electric Power

Learning Outcomes

The students:

1) explain the meaning and means of measurement of work and capacity of electric power and know the units of measurement used;
2) list the important features of the following concepts: electric power appliance, short-circuit, electrical protection and electrical earthing;
3) explain the meaning of the formula $A = I\ U\ t$, $N = IU$ and $A = N \cdot t$, relations with corresponding phenomena and use relations in solving problems;
4) describe the function of electric heaters, their working principle, examples of use and safety regulations; and
5) determine the total capacity of electric appliances and assess its correspondence with the value of electrical protection.

Learning Content

Work of electric power. Electric power capacity. Electric heater. Electrical safety. Short-circuit. Electrical protection. Earthing protection.

Magnetic Phenomena

Learning Outcomes

The students:

1) list the important features of magnetic fields;
2) explain the following phenomena: the magnetic field of the Earth and magnetic poles;
3) know the relations that unlike magnetic poles attract and likes repel, that a magnetic field is created by electrically charged moving particles and describe the importance of these relations in explaining appropriate phenomena or using them in practice;
4) explain the occurrence of the magnetic effect of currents in the example of an electromagnet and electric engine, describe the energy aspects of the work of an electric engine and electric generator and explain the safety regulations in using these instruments; and
5) conduct an experiment making an electromagnet, studying its properties and drawing conclusions about the relations between the properties of the electromagnet.

Learning Content

Permanent magnet. Angle of dip. Magnetic field. Electromagnet. Electric engine and electric generator as energy converters. Magnetic phenomena in nature and technology.

Concepts: electrified body, electric charge, elementary charge, electric field, electric current, free charge carriers, conductor, isolator, electrical resistance, electrical supply, circuit, series connection and parallel connection of chargers, intensity of current, voltage, switch, electric power appliance, work of electric power, electric power capacity, short-circuit, electrical protection, earthing protection, magnetic field

Practical work and use of ICT

1. Studying the phenomenon of electrified bodies.
2. Studying series and parallel connection of chargers.
3. Measuring the intensity of current and calculating resistance.
4. Making and studying an electromagnet.

2.4.4.4. Thermodynamics. Nuclear Energy

Model of Substance Structure. Thermal Movement

Learning Outcomes

The students:

1) explain the models of interaction between solids, liquids, gases and particles;
2) describe the important features of thermal movement and thermal expansion and their relation with other phenomena and use in practice;
3) describe the Celsius temperature scale;
4) explain the law that the faster particles move, the higher the temperature; and
5) explain the function and rules of use of a thermometer.

Learning Content

Gas, liquid and solid. relation between speed and temperature of particles. Thermal expansion. Temperature scales

Heat Transfer

Learning Outcomes

The students:

1) describe the important features of heat transfer, its relation with other phenomena and use in practice;
2) explain the meaning of the amount of heat and means of measuring it, at the same time knowing the units of measurement used;
3) explain the meaning of the thermal capacity of a substance, at the same time knowing the units of measurement used;
4) name the important features of the following concepts: internal energy, temperature change, thermal conductivity, convection and thermal radiation;
5) formulate the following relations and use them in explaining these thermal phenomena:
    a) in the case of thermal phenomena, the internal energy is transferred from a warmer body to a colder one;
    b) the internal energy of bodies can be changed in two ways: through work and heat transfer;
    c) in the case of heat transfer of two bodies, the internal energy of one of the bodies increases exactly as much as the internal energy of the other decreases;
    d) the higher the temperature of a body, the greater the amount of heat the body radiates in a unit of time; and
    e) the darker the surface of a body, the greater the amount of heat the body radiates and also absorbs in a unit of time;
6) explain the meaning of the formulas $Q = c\,m\,(t_2 - t_1)$ or $Q = c\,m\,\Delta t$, where $\Delta t = t_2 - t_1$, and their connection with thermal phenomena and use them in solving problems;
7) explain the function of thermos, solar heating and heating materials, working principles, examples of use and safety regulations; and
8) conduct an experiment measuring the thermal capacity of a body, processing the data of the experiment and drawing conclusions about the material of the body.

Learning Content

Warming and cooling down of bodies. Internal energy. Amount of heat. Thermal capacity of substance. Heat transfer. Thermal conductivity. Convection. Patterns of thermal radiation. Thermos. Solar heating. The law of conservation of energy in thermal processes. Change of seasons. Heat transfer in nature and technology.

Changes in the States of Substances. Thermal Technology Applications

Learning Outcomes

The students:

1) name the important features of melting, solidification, transpiration and condensation, associate them with other phenomena and use them in practice;
2) explain the meaning of the heat of fusion, boiling heat and calorific value of fuel and know the measurement units;
3) explain the meanings of formulas $Q = \lambda\, m$, $Q = L\, m$ and $Q = r\, m$, associate them with other phenomena and use them in solving problems; and
4) solve complex tasks with applicable content that can be reduced to partial tasks.

Learning Content

Melting, solidification and heat of fusion. Transpiration, condensation and boiling heat. Calorific value of fuel. Thermal technology applications.

Nuclear Energy

Learning Outcomes

The students:

1) name the important features of atomic nucleus, electron shells, proton, neutron, isotope, radioactive decay and nuclear reaction;
2) explain the meaning of the relation that energy is released when light nuclei merge and heavy nuclei fuse and associate this with other phenomena;
3) describe *α*-, *β*- and *γ*-radiation and name the difference between types of radiation;
4) explain the use of a nuclear reactor and radiation protection, their working principles, examples of functions and safety regulations; and
5) explain the function and rules of use of a dosimeter.

Learning Content

Atomic models. Structure of atomic nucleus. Nuclear relation energy. Nuclear fission and synthesis. Radioactive radiation. Radiation protection. Dosimeter. Sun. Nuclear power station.

Concepts: thermal movement, thermal expansion, Celsius scale, internal energy, temperature change, thermal conductivity, convection, thermal radiation, heat of fusion, boiling heat; calorific value of fuel, proton, neutron, isotope, radioactive decay, *α*-, *β*- and *γ*-radiation, nuclear reaction

Practical work and use of ICT

Learning about a calorimeter and identifying the thermal capacity of bodies.

2.5. Chemistry

2.5.1. Learning and Educational Objectives of Chemistry

The objective of learning Chemistry in basic school is that by the end of basic school the student would:

1) show an interest in chemistry and other natural sciences and understand the role of chemistry in the historical development of human society, contemporary technology and everyday life;
2) have a responsible attitude towards the living environment, valuing the principles of sustainable development, notice, analyse and assess the effects of human activity and assess and calculate the danger of the materials used in human activities;
3) shape a connected worldview on the basis of the things studied in different fields of natural science, understand the physical nature of chemical phenomena and the chemical background of natural processes;
4) use different sources of chemistry-related information, analyse the information gathered and assess it critically;
5) have acquired literacy in natural science- and technology-related issues equivalent to basic school level, including functional literacy in chemistry;
6) apply scientific method when solving problems;
7) know chemistry-related professions and value chemistry-related knowledge and skills when planning their careers; and
8) take a systemic and creative approach towards solving problems and are motivated for lifelong learning.

2.5.2. Subject Description

Chemistry is a natural science and plays an important role in the shaping of students' scientific and technology literacy. The study of chemistry is based on the knowledge, skills and attitudes acquired in other subjects (Science, Physics, Biology, Mathematics et al.), at the same time supporting the teaching of other subjects.

In studying chemistry, the students acquire a simple but complete understanding of the chemical processes that take place in nature and artificial environments as well as those used in human activities, their relations and their effects on the living environment. The skills of solving everyday life problems and making competent decisions are important, as they form the basis for coping in the natural and social environments. The knowledge, skills and attitudes acquired in chemistry, integrated with that studied in other subjects, form a basis for internally motivated lifelong learning.

In studying chemistry the students acquire an overview of the contemporary technology- and energy-related problems and future directions in chemistry, which help the students in their future choice of profession. The study of chemistry develops the students' understanding about relations between a clean natural environment and health. Studying chemistry shapes the students' sense of responsibility and respect towards nature and develops an ability to assess the direct or indirect consequences of one's decisions or activities.

In study, a inquiry-based approach based on scientific method is used, solving problems arising from the natural, technological and social environments. The studies develop the skills of a creative approach, logical thinking, understanding causal relations, analysis and generalisation.

The students acquire an ability to understand and compile chemistry-related texts, make sense of and use chemistry-related vocabulary correctly, present chemistry-related information by the oral and written presentation using different verbal and visual forms of presentation (verbally and as diagrams, graphs, models and formulas) and used different sources of information, including electronic ones.

Through practical work, the students acquire the skills they need for such work: learning how to safely use instruments for experiments and the chemicals necessary in everyday life and assessing the danger of everyday chemicals and materials used in everyday life and technology for human health and the state of the natural environment. Solving chemistry calculus problems deepens the students' understanding of chemistry problems and develops skills of logical thinking and mathematical applications and teaches the students to understand the quantitative relations between chemical phenomena and draw conclusions and make decisions based on these. In the studies, significant attention is paid to shaping the students' internal studying motivation.

2.5.3. Learning and Educational Outcomes in the 3rd Stage of Study

After completing the 9th grade, students:

1) identify chemistry-related problems in everyday life, the environment and practical human activities;
2) use chemistry terminology and chemistry symbols appropriate to the curriculum correctly and understand simple chemistry texts;
3) use the periodic table, solubility table and reactivity series of metals and find the values of physical quantities from tables and graphs (dissolubility, density of a solution, melting and boiling temperatures etc.);

4) understand the information included in the equations of chemical reactions and compile simple equations of reactions (within the limits of the reaction types studied);
5) apply the principles of scientific studies (problem > hypothesis > experiment > conclusion);
6) plan and safely carry out simple chemistry experiments, understand the danger of the chemicals and materials used in everyday life and apply this knowledge, following the necessary safety regulations;
7) make simple calculations on the basis of chemical formula and reaction equations as well as the contents of solutions, check the plausibility of the equations with dimensional analysis and assess the correspondence of calculation results with reality; and
8) value principles of healthy eating, healthy lifestyles and healthy environments and adopt a sustainable attitude towards these.

2.5.4. Learning Outcomes and Learning Content

2.5.4.1. What Does Chemistry Involve?

Learning Outcomes

The students:

1) compare and categorise substances according to their physical properties: melting and boiling temperature, density, hardness, conductivity, colour etc. (associate them with that studied in Science);
2) know the options for incurring chemical reactions, recognises a reaction by its characteristcs;
3) follow main safety regulations when using chemicals in laboratory work and everyday life and understand the need to follow safety regulations;
4) know the most important laboratory instruments (e.g. test tube, beaker, flask, graduated cylinder, funnel, mortar, porcelain bowl, spirit lamp, test tube holder and stand) and use them correctly in practical work;
5) differentiate between solutions and colloids and give examples of solutions and suspensions in nature and everyday life; and
6) solve calculus tasks based on the percentage constitution of a solution (applying the ratio between the mass of the solution, solvent, dissolved substance and the mass percentage of the solution).

Learning Content

Chemistry around us. Physical properties of substances (application of the things studied in the 7th grade in terms of the properties of substances).

Chemical reactions and their characteristics.

Basic safety requirements. Using chemicals in laboratory work and everyday life. The necessity of following safety requirements. Essential laboratory equipment (e.g. test tube, beaker, flask, graduated measuring cylinder, funnel, mortar, ceramic dish, burner, test tube clamp, clamp holder) and using them in practical work.

Solutions and colloids, sub-types of colloids (foam, aerosol, emulsion and suspension) and gels. Solutions and colloids in nature and everyday life.

Calculations of the percentages composition of solutions (according to mass).

Concepts: chemical, solvent, dissolved substance, colloid solution, emulsion, suspension, aerosol, foam, gel, mass percentage of solution

Practical work and use of ICT

1. Studying and describing the physical properties of substances (aggregate state, melting and boiling temperature, density in relation to water, colour etc.).

2. Making different types of colloid solutions (suspension, emulsion, foam etc.) and studying their properties.
3) Investigating the characteristics of a chemical reaction.

2.5.4.2. Atomic Structure and Periodic Table: Composition of Substances

Learning Outcomes

The students:

1) explain atomic structure (associating it with the things previously studied in Science);
2) associate the names and symbols of the most important chemical elements (up to 25 e.g. H, F, Cl, Br, I, O, S, N, P, C, Si, Na, K, Mg, Ca, Ba, Al, Sn, Pb, Fe, Cu, Zn, Ag, Au and Hg) and correctly read the symbols of chemical elements in a formula for a substance;
3) associate the location of a chemical element in the periodic table (in A-groups) with the atomic structure of the element (nuclear charge or number of protons in the nucleus, number of electron layers and number of electrons in the outer layer) and compile the electron scheme of the element on the basis of the serial number of the chemical element (for A-group elements in 1–4 periods);
4) know the differentiation metallic and non-metallic chemical elements, give reasons for their location in the periodic table and give examples of the use of metals and non-metals in everyday life;
5) differentiate between simple and complex substances (chemical compounds);
6) differentiate between ions and neutral atoms and explain the occurrence and charge of ions;
7) explain the differences between covalent and ionic bonds; and
8) know that there are differences between mulecular (consisting of molecules) and non-molecular substances and give examples of these.

Learning Content

Atomic structure. Chemical elements and their symbols. Periodicity of the properties of chemical elements and the periodic table. The relation of the periodic table to the electron structure of atoms: nuclear charge, number of electron layers and number of electrons in the outer layer (electron schemes). Metallic and non-metallic properties of chemical elements, metallic and non-metallic elements in the periodic table and metals and non-metals.

Simple and compound substances (chemical compounds). Molecular formula. Overview of chemical bonds between the atoms in a molecule (covalent bond). Creation of ions of atoms and charges of ions. Differences between atoms and ions. Substances that consist of ions (ionic substances). Overview of ionic bonds (introduction). Molecular and non-molecular substances (in the example of metals and salts).

Concepts: chemical element, atomic number of element (sequential number), number of electrons in the outer layer, periodic table, simple substance, compound substance (chemical compound), atomic mass, molecular mass (formula mass), metal, non-metal, ion, cation, anion, covalent bond, ionic bond, molecular substance, non-molecular substance

Practical work and use of ICT

1. Searching for information from the Internet about chemical elements and comparing and systematising them.
2. Compiling and studying molecular models.

2.5.4.3. Oxygen and Hydrogen: the Most Common Compounds

Learning Outcomes

The students:

1) explain the role of oxygen in combustion and wildlife (associating it with the things previously studied in Science and Biology), analyse the importance of the ozone layer and its destruction due to pollution;
2) describe the main properties of oxygen and hydrogen;
3) associate the appropriate measure for collecting gas (oxygen, hydrogen, carbon dioxide etc.) with the corresponding properties of gas (density of gas in relation to air and solubility in water);
4) on the basis of the formula of the substance, determine the oxidation levels of its composites and prepares the formulas of oxides on the basis of the oxidation levels of the elements;
5) prepare the formulas on the oxides on the basis of their names and vice versa;
6) compile reaction formulas in regard to the compound reactions of the most common simple substances (e.g. H_2, S, C, Na, Ca and Al) with oxygen and give examples of the best know oxides in everyday life (e.g. H_2O, SO_2, CO_2, SiO_2, CaO and Fe_2O_3).

Learning Content

Oxygen, its properties and role in combustion and wildlife. Combustion and creation of oxides. Level of oxidization. Names of oxides and compilation of their formulas. Oxides in everyday life. Compound reaction. Compiling and balancing simpler formulas of combustion. Methods for collection of gases. Hydrogen and its physical properties.

Concepts: combustion, oxide, level of oxidisation, merging reaction.

Practical work and use of ICT

1. Producing and proving the presence of oxygen and burning a candle under a cloche.
2. Depicting combustion with the help of molecular models.
3. Producing CO_2 and using it to extinguish a fire.
4. Producing hydrogen and checking its purity.

2.5.4.4. Acids and Bases: Substances of Opposing Properties

Learning Outcomes

The students:

1) recognise (according to formulas) acids, hydroxides (as the best known bases) and salts and compile the formulas of hydroxides and salts according to names (and vice versa);
2) make associations between the formula and names of more important acids and acid ions (HCl, H_2SO_4, H_2SO_3, H_2S, HNO_3, H_3PO_4, H_2CO_3, H_2SiO_3); forms the formula of hydroxides and salts on the basis of their names (and vice versa)
3) understand the opposite nature of acids and bases (ability to neutralise each other);
4) assess the acidity, alkalinity or neutrality of a solution according to its pH and identify the environment (neutral, acid or alkaline) in a solution using an indicator;
5) give examples of the best know acids, bases and salts in everyday life;
6) follow safety regulations when working with alkali and strong acids;
7) compile and balance formulas of the reactions between simple acids and bases, carry these reactions out in a safe manner; and
8) understand the principle of balancing reaction formulas (the number of atoms in elements does not change in chemical reactions).

Learning Content

Acids and their components. Most important acids. Safety regulations in the event of using strong acids.

The components and names of hydroxides (as the most known bases). Safety regulations in the case of using strong bases (alkali). The reaction of acids to bases and neutralisation reaction. The pH-scale of

solutions and its use when describing the acidity/alkalinity of solutions. Salts, their components and names. Acids, bases and salts in everyday life.

Concepts: acid, base, indicator, neutralisation reaction, pH-scale of acids, salt

Practical work and application of information and communication technology

Identifying the indicator of acids and bases and studying the neutralisation reaction, producing salts with a neutralization reaction.

2.5.4.5. Best Known Metals

Learning Outcomes

The students:

1) associate the physical properties characteristic to metals (good electrical and thermal conductivity, lustre and plasticity) with the characteristics of metallic bonds;
2) differentiate between active, medium-activity and low-activity metals and assess the activity of metals (active, medium activity or low activity) according to the location of the metal in the reactivity series of metals;
3) considering safety requirements, conduct experiments to study reactions between metals and acids, compare the speed of these reactions (qualitatively), associate the difference in speed with the difference in the reactivity of different metals and the reaction conditions (temperature, level of shredding of the solid substance);
4) associate the redox reactions with the changing of oxidisation levels of chemical elements;
5) know the behaviour of metals in chemical reactions as a reducer and the behaviour of oxygen as an oxidiser;
6) compile reaction equations in regard to the chemical reactions characteristic of chemical reactions (metal + oxygen and metal + acid solution);
7) assess the possibilities of application of the best known metals and their alloys (Fe, Al, Cu etc.) and associate these with the physical and chemical properties of corresponding metals; and
8) associate the transfer of metals, including corrosion atoms of iron, into more permanent states (chemical compounds), name the main factors that contribute to the corrosion of iron (rusting) and explain the possibilities for corrosion inhibition.

Learning Content

Metals, the characteristic properties of metals and overview of metallic bonds (introduction). Comparison of physical properties of metals.

The reaction of metals to hydrogen and other basic substances. Changes in the oxidation numbers of elements in chemical reactions. Metals as reducers and oxygen as oxidant. The reaction of metals with acid solutions. Overview of speed of reaction (in the example of the reaction between a metal and an acid solution. Comparison of the activity of different metals (active, medium-activity and low-activity metals) and introduction to reactivity series of metals.

The most important metals and their alloys in everyday life (Fe, Al, Cu etc.). Corrosion of metals (in the example of iron).

Concepts: active, medium-activity and low-activity metal, reactivity series of metals, reducer, reduction, oxidiser, oxidation, redox reaction, reaction speed, alloy, corrosion of metals

Practical work and use of ICT

1. Comparing the physical properties of metals (hardness, density, magnetic properties etc.).
2. Finding information from the Internet about the properties and possibilities of use of metals and comparing and systematising them.
3. Comparing the activity of metals when reacting with acid solutions (e.g. Zn, Fe, Sn, Cu).

4. Studying the corrosion of iron in different conditions.

2.5.4.6. Main Classes of Inorganic Substances

Learning Outcomes

The students:

1) differentiate between strong and weak acids and bases and associate the acidic characteristics of a solution with the occurrence of H^+ ions and alkaline characteristics with the occurrence of OH^- ions in the solution;
2) use the relations between classes of substances when explaining the reactions between substances, compiling the corresponding reaction equations (within the limits of the reaction types studied: basic substance + O_2, acid oxide + water, (strongly) alkaline oxide + water, acid + metal, acid + base, alkaline oxide + acid, acid oxide + base and hydroxide decomposition when heating) and conducting these reactions in safely;
3) use the solubility table of substances to find the necessary information;
4) explain the impact of temperature on the solubility of gases and (most) salts in water, uses the solubility graph of substances to find necessary information and make calculations and conclusions;
5) solve calculus problems based on the percentage composition of a solution (including using the volume and density of a solution);
6) describe and analyse the main properties of some of the most important inorganic compounds (H_2O, CO, CO_2, SiO_2, CaO, HCl, H_2SO_4, NaOH, $Ca(OH)_2$, NaCl, Na_2CO_3, $NaHCO_3$, $CaSO_4$, $CaCO_3$ etc.) and explain the use of these compounds in everyday life; and
7) analyse the-sources of chemical pollution and reasons for pollution, environmental problems caused by pollution (acid precipitation, heavy metal compounds, over-fertilisation, and possible measures to save the environment.

Learning Content

Oxides. Acid and alkaline oxide and their reaction to water.

Acids. Strong and weak acids. Chemical properties of acids (reacting to metals, alkaline oxides and bases). Acids in everyday life.

Bases. Classification of bases (strong and weak bases, well-soluble and hard-soluble bases) and chemical reactions (reaction to acid oxides and acids). Components and names of hydroxides.

Salts. Hydrogen salts (in the example of cooking soda). Water as a solvent. Solubility of substances in water (quantitatively), its dependence on temperature (gases and salts). Solubility table. Calculations of percentage composition of solutions (considering density).

Relations between the main classes of inorganic substances.

Inorganic compounds in everyday life. Roughness of water, fertilisers and construction materials.

Main sources of chemical pollution and environmental problems: acid rain (acid precipitation), pollution of the environment with heavy metal compounds, pollution of bodies of water.

Concepts: acid oxide, alkaline oxide, strong acid, weak acid, hydrogen acid, strong base (alkali), weak base, roughness of water, solubility.

Practical work and use of ICT

1. Studying the reaction between different oxides and water (e.g. CaO, MgO, SO_2 + H_2O).
2. Studying the reactions between different oxides and acids or bases (e.g. CuO + H_2SO_4, CO_2 + NaOH).
3. Finding information from the Internet about the acidity/alkalinity of everyday chemicals and drawing conclusions.
4. Studying the reactions between different types of acids and bases.

5. Studying the solubility of salts at different temperatures

2.5.4.7. Amount of Substance: Mole Calculations

Learning Outcomes

The students:

1) know the basic units of the amount, mass and volume of a substance (mol, kmol, g, kg, t, cm^3, dm^3, m^3, ml and l) and make the necessary transformation of units;
2) make calculations according to the relations between the amount and mass of a substance and volume of gas and explain them logically;
3) understand the conservation of the mass of substances in chemical reactions and the meaning of the reaction equation coefficient (the ratio of the amounts of the reacting substances;
4) analyse the information included in the chemical reaction equation (qualitative and quantitative);
5) solve calculus tasks based on reaction equations, following the reaction equation coefficients (the mole ration of substances) and the amounts of the substances involved in the reaction (number of moles), recalculating if necessary on the basis of the relations between the amount and mass of substances and (gas) volume, and explain the process of calculation; and
6) logically assess the validity of the calculation results, draw conclusions and make decisions on the basis of the calculation results.

Learning Content

Amount of substance and mole. Molar weight and molar volume of gas (in normal conditions). Units for amounts of substances and their conversion. Conservation of mass in chemical reactions. The meaning of the coefficients in a reaction equation.The analysis of the (qualitative and quantitative) information in an equation of a chemical reaction. Calculations according to reaction equations in moles (including based on mass or volume).

Concepts: amount of substance, mole, molar weight, molar volume of gas, normal conditions

2.5.4.8. Carbon and Carbon Compounds

Learning Outcomes

The students:

1) compare and explain the properties of the basic substances of carbon and compare the properties of carbon oxides;
2) analyse the reason for the multiplicity of carbon compounds (the ability of carbon to compile linear and branched chains, cycles and multiple bonds);
3) compile the structural formulas of carbon compounds on the basis of the number of given atoms (C, H and O) (taking into account the number of covalent bonds that the atoms of carbon, oxygen and hydrogen form);
4) know about classifying materials as hydrophilic and hydrophobic and able to bring examples from everyday life;
5) describe the forms of hydrocarbons that are present in nature (natural gas and petroleum) and areas of use (fuels and lubricating preparations) and explain the possibilities of their use in practice;
6) differentiate (according to the structural formula of hydrocarbons) alcohols and carbonic acids;
7) compile the equations characteristic of chemical reactions for acetic acid (within the limits of the reaction types studied) and do experiments in order to study the reactions; and
8) assess the physiological effect of ethanol and the problems connected to it in everyday life.

Learning Content

Carbon as a basic substance. Carbon oxides. Hydrocarbons. Multiplicity of carbon compounds. The ability of carbon to form linear and branching chains, cycles, multiple bonds. Molecular models and structural formulas. Overview of polymers.
Forms of occurrence of hydrocarbons in nature (natural gas, oil), areas of application (fuels, lubricants) and different uses. Complete combustion of hydrocarbons (compiling and balancing reaction equations). Hydrophilic and hydrophobic substances. The most important representatives of alcohols and carbonic acids (ethanol and acetic acid), their properties and importance in everyday life and physiological effect of ethanol.
Concepts: hydrocarbon, structural formula, polymer, alcohol, carbonic acid
Practical work and use of ICT
1.Producing CO_2 and using it for extinguishing fire;
2. Compiling the molecular models of simple hydrocarbons and other carbon compounds
3. Compiling the molecular models of carbon compounds and studying them in a computer environment (with the help of corresponding software)
4. Studying the properties of hydrocarbons (solubility and wetting in water)
5. Studying the combustion reactions of different carbon compounds (e.g. ethanol and paraffin)
6. Studying the acidic properties of acetic acid (e.g. acetic acid + sodium carbonate, acetic acid + caustic solution)

2.5.4.10. The Role of Carbon Compounds in Nature and Carbon Compounds as Materials
Learning Outcomes
The students:
1) explain the thermal effect of chemical reactions (release or absorption of energy);
2) assess the role of carbon compounds important for life (saccharides, fats and proteins) in living organisms and know the final products of their transformation in organisms (water and carbon dioxide) (associated with the things studied in Science and Biology);
3) analyse the possibilities of using carbon compounds as fuel and distinguish between renewable and non-renewable sources of energy (associated with the things previously studied in Science);
4) characterise the materials that are based on the best known carbon compounds (fibres and plastics) and analyse their main properties and possibilities of use;
5) understand the necessity of having a sustainable attitude towards the living environment and analyse the possibilities of sustaining the environment.

Learning Content
Energy release and absorption in chemical reactions. Exothermic and endothermic reactions.
Carbon compounds necessary for life (saccharides, fats and proteins) and their role in organisms. Principles of healthy eating and healthy lifestyles.
Carbon compounds as fuel. Environmental problems: greenhouse gases. Products of consumer chemistry, plastics and fibres. Polymers in everyday life.
Concepts: exothermic reaction, endothermic reaction, thermal effect of reaction (qualitatively).
Practical work and use of ICT
Melting of fat and studying fat solubility in different solutions

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