

DIATHEMATIKON PROGRAMMA
CROSS-THEMATIC CURRICULUM FRAMEWORK
FOR BIOLOGY

1. Teaching/learning aim

Biology is the science that studies life phenomena and processes as well as living organisms, including humans, both in their natural and in laboratory environments. In recent years, there is a growing interest in improving human life quality and a serious concern for social and environmental problems, such as health problems, degrading environmental conditions, malnutrition, overpopulation, etc. Biology is the science that can suggest solutions to these problems today and this implies a considerable increase of information and knowledge in its various subfields. The rapid development of the science of Biology and the continuous updating of its findings, part of which should now be accessible to the pupils, necessitates content organization in the Biology curriculum in such a way that content modifications and adaptations will be possible, when and to the extent this is considered necessary. Moreover, emphasis should be placed on pupils' familiarization with scientific methods, in order to help them not only acquire core knowledge of the subject but also develop their ability for lifelong learning, including understanding, exploring and purposefully applying scientific knowledge. The following things should also be taken into consideration in Biology teaching: the fact that understanding scientific concepts presupposes acquiring core knowledge of the specific science and that each concept consists the basis on which new concepts will be constructed.

Considering all the above, the aim of teaching Biology in compulsory education is to shape well-rounded persons by developing pupils' critical thinking ability along with a positive attitude towards initiative taking and active involvement on both a personal and interpersonal level. More specifically pupils should be given opportunities to develop respect for organisms, life and the environment. Also pupils should become able to recognize the unity and continuity of knowledge in the context of Biological Sciences and use the knowledge and skills they acquire in order to interpret phenomena or processes that relate to themselves or to their environment. They develop environmental awareness, learning to evaluate data, identify the causes of environmental problems and suggest possible solutions as well-informed individuals.

2. Content Guiding Principles, General Goals, Indicative Fundamental Cross-

thematic Concepts

Biology topics included in both Elementary and Junior High school Biology curriculum have been organized according to grade level, on the basis of content guiding principles, which should be considered only as guidelines for content organization and not as independent areas of study. These content guiding principles are developed and organized in relation to content according to grade level and pupils' age and perceptive ability. Also, the teaching aim of the subject should always be taken into consideration.

General goals are grouped according to Knowledge and Methodology, Cooperation and Communication, Science and Technology in every day life guiding principles and derive from the teaching aims mentioned in the general part of the Cross-thematic Curriculum Framework.

Knowledge and Methodology

Pupils should be able to:

- recognize variation in organisms, classify them according to specific criteria, and distinguish their structural and functional similarities and differences relating them to their environment specific needs;
- understand the relationship between structure and function at all life organization levels, as well as the interrelationship between the components of a biological system, and also between the latter and abiotic environment;
- recognize, name and describe, using scientific language, basic parts of an organism and understand the role of each part in the function of the organism;
- distinguish factors affecting the balance of biological systems and recognize the self-regulating ability of these systems;
- distinguish similarities in the life cycle of various organisms, distinguish characteristics that are inherited from one generation to the next and correlate this process with the mechanisms of passing on genetic information both at cell and organism level (inheritance);
- use their knowledge to understand or give simple explanations of phenomena and processes related to human organisms and their environment;
- relate defense mechanisms to the maintenance of human body's balance and justify the significance of personal choices and the timely and reliable information of the public on the issue of health maintenance;
- relate environmental problems to human activity;
- relate variation in organisms and life processes to the evolution process;

- observe through their senses, carry out simple experiments following specific instructions, handle simple devices and equipment, record their observations or experiment results and draw conclusions;
- study a biological issue following scientific methodology and exploiting technology and different sources of information.

Cooperation and Communication

- follow instructions and time schedules when engaging in projects, and cooperate with their classmates, their teacher and other people or organizations in their community;
- communicate scientific information (including observations or conclusions regarding biological processes or phenomena), through diagrams, simple tables, charts etc., in speech and writing.

Biology in everyday life

- justify the relationship of consumerism with the individual's mental and physical health on the one hand, and with maintaining balance in the natural and social environment on the other;
- use their knowledge to explain phenomena, processes or problems they encounter, and also to take care of and protect themselves and their environment;
- realize how the applications of Biology can help solve various social problems and improve human life quality;
- realize the importance of landmarks in the development of the Science of Biology and relate them to their social and scientific context;
- justify how important it is for individuals' to participate in social processes and realize their power to intervene as citizens;

The above aims are further specified according to grade level so that teaching can assist pupils acquire knowledge of concepts, phenomena or processes, as well as the skills they will be able to use, in order to present, interpret and evaluate information and formulate personal opinions in order to be able to function as free and responsible individuals within their social context.

The study of Biology at all educational levels, including Compulsory Education, is structured around biological systems. These systems-characterized by the great number of different elements they are made up of, by their complex structure, by their multidimensional relations and by the fact that they exist only in relation to broader systems that they consist parts of-should not be studied as individual systems but in relation to other systems that consist part of a whole. Therefore the concept of system, consisting of specific parts that interact with each

other, is fundamental in the teaching of Biology. Other concepts that emerge during the study of biological systems are their 'distinction' from their environment, the 'diversity' of its parts, and the relation between 'structure' and 'function' of its parts in such a way so as to ensure the function of the whole system. During the study and teaching of Biology it is important to distinguish the different parts of systems and the 'interdependence' relations developed among them, as well as between them and their environment. Concepts emerging during the study of the interdependence relation are the exchange and transfer of 'energy', 'matter' and 'information', together with 'function distribution' in the system parts. Biological systems are characterized by their ability to maintain 'balance'. Their balance is dynamic rather than static in the sense that each internal or external change or alteration tending to destabilize the system is prevented through activation of proper 'self-regulating mechanisms. When studying the balance of all biological systems, the concepts of 'evolution' in relation to 'time' and 'position' emerge, while the concepts of 'inheritance' and 'evolution' are gradually introduced. These concepts are fundamental in the teaching of Biology, and can contribute to the cross-thematic approach to knowledge.

I. Primary school

In selecting Biology topics to be taught in elementary school, pupils' interest in acquiring knowledge of themselves as well as of the many living organisms (animals and plants) which surround them was taken into consideration. In studying these organisms in their environment and trying to distinguish similarities and differences between them, pupils will soon realize the need to classify them, and will start doing so. At this point it is necessary for pupils to realize that the environment is not static or unchangeable, and that its study is inexhaustible. Indeed, because it is continuously changing, there have been made efforts to ensure that pupils are given opportunities in the DP to observe and understand change to a certain extent, in order that they can foresee future changes and be able to act accordingly. All the above facts prove how important the study of the environment is for elementary school pupils. Content organization, as it is proposed, is in accordance with the view that learning is not just a process of recording external reality in the pupils' brain but a whole process of thinking and acting that interacts with affects thinking.

The following content guiding principles have been selected for elementary school: 'plants', 'animals', 'humans', and 'the environment'. Biology content for elementary school

has been selected on the basis of these principles and according to grade level, and is as follows:

Grade	Content Guiding Principles	General Goals (Knowledge, skills, attitudes, values)	Indicative Fundamental Cross-thematic Concepts
1 st	<p>Plants</p> <p>Plants in the local environment</p> <p>Parts of a plant (root, stem, flower)</p> <p>Classifying plants familiar to pupils according to their morphological characteristics (herbs, bushes, trees), leaves maintenance (deciduous-evergreen), habitat (garden, field/farm, orchard, slope, forest)</p>	<p>Pupils should:</p> <p>identify plants in the local environment, recognize variation of form and structure and classify them into major taxonomic groups;</p> <p>develop an interest in plants in the local environment and use their knowledge to take care of them.</p>	<p>System</p> <p>Space/Habitat</p> <p>Time</p> <p>Classification</p> <p>Change</p>
	<p>Animals</p> <p>Animals in the local environ-</p>	<p>identify animals in the local environment, recognize variation of form and structure and classify them into major</p>	<p>System</p> <p>Space/Habitat</p> <p>Classification</p>

	<p>ment.</p> <p>External parts of the animal body (head, legs, tail etc.)</p> <p>Classifying animals familiar to pupils according to the way they move (swimming, creeping, stepping), behavior (wild, domesticated) and habitat (home, field, lake, sea, river, forest)</p>	<p>taxonomic groups;</p> <p>develop an interest in animals and use their knowledge to take care of them.</p>	
	<p>Humans</p> <p>External parts of the human body</p> <p>Perceiving the world around them through their senses and sense organs</p> <p>Personal hygiene emphasizing on the role of teeth and their protection</p>	<p>identify the main external parts of the human body and recognize the role of sense organs as means of perceiving and communicating with the environment;</p> <p>adopt attitudes and behaviors contributing to health maintenance.</p>	<p>System</p> <p>Communication</p>
	<p>The environment</p> <p>Distinguishing</p>	<p>understand the relationship between the environment and human life quality.</p>	<p>Classification</p> <p>Communication</p>

	<p>between living and abiotic things.</p> <p>Care of plants and animals</p> <p>Care for the pupils' immediate environment (classroom, school, home)</p>		
2 nd	<p>Plants</p> <p>Observing the growth of plants</p> <p>Factors affecting plant growth (light, water, temperature).</p>	identify the factors affecting plant growth.	<p>Change</p> <p>Classification</p> <p>Adaptation</p>
	<p>Animals</p> <p>Animal development</p> <p>Factors affecting animal growth (light, water, temperature)</p> <p>Classifying animals according to their morphological characteristics (type of limbs, body cover) and</p>	identify the factors affecting animal development.	

	<p>their eating habits (carnivores-herbivores)</p>		
	<p>Humans Human life cycle (birth-development-maturation-old age)</p>	<p>identify the main stages of the human life cycle.</p>	<p>Change Time</p>
	<p>The environment Care for and protection of the local environment (neighborhood, district).</p>	<p>realize how the environment affects human life quality and be actively involved in its care and protection.</p>	<p>Communication</p>
3 rd	<p>Plants Plants commonly grown in Greece (olive, vine, legumes, cereals) Kinds of roots–the important role of the root in the life cycle of plants Classifying plants according to external morphological characteristics (stem form, leaf texture and</p>	<p>realize the significant role of common plants of Greece in their everyday life; realize the important role of the root in the life cycle of plants; classify plants into the major taxonomic groups according to specific morphological characteristics.</p>	<p>System Variation Function Classification</p>

	shape, stem type)		
	<p>Animals</p> <p>Domesticated animals commonly found in Greece</p> <p>How major taxonomic groups of animals (oviparous, viviparous) reproduce</p> <p>Classifying organisms according to their habitat (terrestrial, aquatic)</p>	<p>recognize the importance of specific animals of Greece in their daily life;</p> <p>classify animals according to their way of reproduction and their habitat.</p>	<p>System</p> <p>Variation</p> <p>Classification</p> <p>Function</p>
	<p>Humans</p> <p>Human nutritional/dietary needs</p> <p>The functions of teeth and the importance of dental care</p>	<p>realize the importance of food for human growth, development and health;</p> <p>develop a positive attitude towards healthy eating and keeping healthy.</p>	<p>Interaction</p>
	<p>The environment</p> <p>Adaptation of plants and animals to daily and seasonal changes in their habitats</p>	<p>understand how organisms are adapted to survive in their habitats;</p> <p>realize the significance of human participation in the protection of the wider environment.</p>	<p>Change</p> <p>Adaptation</p> <p>Balance</p>

	Protection of the wider environment (community, town/city)		
4 th	<p>Plants</p> <p>Wild plants occurring in Greece</p> <p>Parts of a flower (blossom, bud)-fruit</p> <p>The life cycle of plants (pollination, seed production, dispersal and germination;</p> <p>Classifying plants according to their fruit and seeds.</p>	<p>find relationships between the characteristics of different habitats and the plants that grow in them;</p> <p>relate flowers (blossom, bud) and fruits with the process of plant reproduction.</p>	<p>Variation</p> <p>Classification</p> <p>Change</p> <p>Adaptation</p> <p>Growth</p>
	<p>Animals</p> <p>External hereditary characteristics</p> <p>Wild animals commonly found in Greece–</p> <p>Protected species</p> <p>Classifying ani-</p>	<p>recognize relationships between different habitats and the animals found in them;</p> <p>understand how certain characteristics are inherited from parents to offspring;</p> <p>classify animals into vertebrate (those that have a vertebral column) and invertebrate (those that have no vertebral column)</p>	<p>Classification</p> <p>Space/Habitat</p> <p>Similarity</p> <p>Adaptation</p> <p>Inheritance</p>

	<p>mals into vertebrate and invertebrate</p> <p>Characteristic invertebrate–Bees.</p>		
	<p>Humans</p> <p>Human skeleton (parts of the human skeleton–bones)–Muscles</p> <p>Human movement (the coordination of bones and muscles)</p> <p>Practices contributing to maintaining the musculoskeletal system in good condition</p>	<p>understand the role of the skeleton and muscles in movement;</p> <p>adopt practices contributing to maintaining the musculoskeletal system in good condition.</p>	<p>System Interaction</p>
	<p>The environment</p> <p>Environmental problems–The impact of human activity on the environment (litter-recycling; air, water and soil pollution).</p>	<p>realize the importance of their participation in the protection of the environment.</p>	<p>Space/Habitat Change Communication</p>
5 th	<p>Plants</p> <p>Root geotropism–</p>	<p>relate certain plant functions to environmental conditions.</p>	<p>Space–Time Change</p>

	Sprout phototropism (heliotropism)		Adaptation
	Animals Characteristics of vertebrate-Mammals	identify main vertebrate characteristics, placing special emphasis on mammals.	Variation Similarity Classification
	Humans Digestive system (special reference to the role of teeth)–food processing-factors affecting digestion–Nutrients Circulatory system (heart, vessels)–Factors affecting its function (exercise, diet) Vision–the eye	relate human body functions to survival needs (nutrition–circulation–vision)	System Change Adaptation Balance Communication
	The environment Microorganisms (useful and harmful) Food relationships between organisms (simple food chains)	identify relationships between organisms in an ecosystem and the factors affecting them.	Change Interdependence

	<p>Typical ecosystems of Greece</p> <p>Environmental problems caused by human intervention in the food chain</p>		
6 th	<p>Plants</p> <p>Plant functions (photosynthesis, transpiration)</p>	<p>realize the significant role of certain plant functions (photosynthesis, transpiration) for plant life.</p>	<p>Space/Habitat Adaptation Change</p>
	<p>Humans</p> <p>Respiration Respiratory organs– Factors affecting their function (smoking, air pollution, speaking)</p> <p>Blood Circulation Blood and its role in the human organism–Factors affecting blood circulation and health (smoking, alcohol drinking)</p> <p>Hearing–the ear</p> <p>Reproduction–a human being is born</p>	<p>relate the functions of the human organism to its survival needs (respiration, hearing, reproduction);</p> <p>follow hygiene rules in order to protect themselves from pathogenic microorganisms.</p>	<p>System Interaction Balance Change Inheritance</p>

	<p>Pathogenic microorganisms, Contagious diseases (emphasis on infantile diseases)–Prevention (Personal hygiene rules, vaccines)–Medicines</p>		
	<p>The environment Structure of an ecosystem–food relationships (Food webs) Different ecosystems found around the world (rainforest, tundra, etc.) Global environmental problems–Human contribution in them</p>	<p>realize there is continuous interaction between the parts of an ecosystem; recognize how the natural environment is affects human life quality and be actively involved in its protection.</p>	<p>System Change Interaction Balance–Self regulation Communication</p>

II. Junior High school

1. Teaching/learning aim

The aim of teaching Biology in Junior High school-whereby compulsory education is completed-is to provide pupils with the necessary knowledge and skills, that will enable them to understand the processes taking place in their body and in the environment, on the one

hand, and on the other to make critical judgments and evaluate data, and as citizens make conscious choices regarding everyday life issues concerning themselves and the social community they are part of.

In Junior High school Biology is taught separately from the other natural sciences. Observation and experimentation are the main methodological tools used in the study of organism structure, functions and processes, giving pupils the opportunity to become familiar with the principles of scientific methodology. Pupils should be taught to consider how Biology relates to different areas of social activity and critically appraise its applications in relation to the efforts made for the improvement of human life quality. They are also taught to encounter issues concerning life on our planet, developing thus problem solving and critical thinking skills.

Life processes are studied in different organisms—from the simplest unicellular ones to the most complex one, the human organism. Thus, pupils will be given the opportunity to consider evolution of the structural characteristics of organisms and life processes. As far as the human organism is concerned, Biology study extends to include factors affecting the function of organ systems. In this way pupils will become aware of the effects of these factors on human health. In the study of environmental issues, emphasis is placed on how the distribution of organisms in a habitat can be explained in terms of, predation, competition adaptation and evolution. At the same time, pupils will be given opportunities to consider the impact of the irrational use of natural resources and modern human lifestyle on human life quality, the environment, as well as on other organisms. This kind of discussion will enable pupils to develop a sense of responsibility together with positive attitudes and stances towards the environment. Finally, the study of issues relating to the fields of genetics, evolution, molecular biology and biotechnology will give pupils the opportunity to acquire the knowledge and skills necessary to become thinking, well-rounded and balanced people as well as well-informed and contributing members of society. These factors combine to enable pupils to develop as ‘responsible and active citizens’.

Content Guiding Principles, General Goals, Indicative Fundamental Cross-thematic Concepts

The following have been proposed as content guiding principles: ‘The science of Biology’, ‘Life Organization–Biological systems’ ‘Organisms in their habitat–Life processes’. According to these principles, the subject content for each grade level is as follows:

Grade	Content Guiding Principles	General goals (Knowledge, skills, attitudes and values)	Indicative Fundamental Cross-thematic Concepts
1 st	<p>Biology science</p> <p>Different approaches to the study of organisms</p> <p>Introduction to scientific methods</p> <p>Biology in everyday life</p>	<p>Pupils should:</p> <p>realize how scientific methods can be applied to the study of life processes;</p> <p>realize how Biology and its applications can contribute to the improvement of human life quality.</p>	<p>System</p> <p>Diversity</p>
	<p>Life organization–Biological systems</p> <p>Non-living things–</p> <p>Organisms–</p> <p>Biosphere</p> <p>Variation and classification of organisms</p> <p>Attributes of life–</p> <p>Relationship between structure and function</p>	<p>distinguish organisms from non living things;</p> <p>identify variation within species and between species and classify organisms using keys;</p> <p>make connections between organism functions and their structural characteristics;</p> <p>justify the definition of cell as the basic structural and functional unit of organisms;</p> <p>distinguish life organization levels and</p>	<p>System</p> <p>Classification</p> <p>Variation</p> <p>Organization–</p> <p>Structure–</p> <p>Function</p> <p>Adaptation</p>

	<p>The cell—the smallest unit of living matter</p> <p>Life organization levels (from cells to organisms)</p>	<p>recognize increase in complexity from one level to the next.</p>	
	<p>Organisms in their habitat- Life processes</p> <p>Relationship of organism structure with the needs created by their habitat.</p> <p>Life processes/functions (nutrition, substance transfer, excretion, respiration, support-movement, reproduction, stimulation–sense organs</p>	<p>recognize organism interaction and interdependence with the environment in which they live;</p> <p>compare organism survival in diverse environments and with specific adjustments;</p> <p>relate organism functions to their survival needs (nutrition, reproduction, movement, etc);</p> <p>distinguish the connection between organism development with increasing complexity of diverse life functions;</p> <p>recognize the relationship between lifestyle and maintaining human’s health.</p>	<p>System</p> <p>Organization</p> <p>Structure-Function</p> <p>Interaction</p> <p>Adaptation</p> <p>Change</p> <p>Evolution</p> <p>Balance–</p> <p>Self regulation</p> <p>Communication</p> <p>Distribution</p> <p>Cooperation</p>
3 rd	<p>Biology</p> <p>Subject of study and principles of Biology</p> <p>Scientific methods</p>	<p>apply scientific method to solve a simple problem;</p> <p>recognize and evaluate the contribution of biology applications to improving human life quality.</p>	<p>System</p> <p>Organization</p> <p>Space</p> <p>Time</p> <p>Balance</p>

	The contribution of Biology to the improvement of human life quality		
	<p>Life organization</p> <p>Molecules</p> <p>The cell: The smallest unit of living matter</p> <p>Life organization levels (from cells to ecosystems)</p> <p>Balance in biological systems– Relationships between organisms</p> <p>Structure and function of an ecosystem–The role of energy</p> <p>The impact of human activity on the environment– Pollution</p>	<p>distinguish life organization levels from molecules to biosphere and recognize that attributes of each level do not simply constitute the sum of attributes of all previous levels;</p> <p>recognize continuous interaction between members of an ecosystem;</p> <p>compare energy with balance existing in biological systems.</p>	<p>System</p> <p>Structure-Function</p> <p>Distribution</p> <p>Organization</p> <p>Interdependence</p> <p>Change</p> <p>Communication</p>
	<p>Organisms in their habitat–</p> <p>Life processes</p> <p>Human organisms</p>	<p>relate the ability of the human body to maintain a stable internal environment with its ability to survive in different environments;</p>	<p>System</p> <p>Organization</p> <p>Space–Time</p> <p>Interdependence</p>

	<p>in their environment–Energy needs of human organism</p> <p>Nutrition, enzymes, metabolism</p> <p>Homeostasis– Factors affecting it</p> <p>Diseases–Body defense against pathogenic factors</p> <p>Life maintenance–DNA– Genetic information transfer (DNA replication, transcription, translation</p> <p>Cell division</p> <p>Inheritance– Genetic variation</p> <p>Genetic Engineering– Biotechnology (general princi-</p>	<p>identify environmental factors (pathogenic microorganisms, etc) which disturb the human body’s homeostasis and identify the defense mechanisms of the human body;</p> <p>consider the relationship of genes with the genetic information defining the structural and functional characteristics of organisms;</p> <p>understand how genetic information is transferred in cells;</p> <p>understand inheritance mechanisms in organisms;</p> <p>realize that the process of human species evolution should be placed in the wider frame of species evolution on our planet.</p>	<p>ence</p> <p>Change</p> <p>Balance-</p> <p>Self regulation</p> <p>Adaptation</p> <p>Evolution</p> <p>Inheritance</p>
--	--	---	---

	ples, applications) Evolution of species (basic principles, human evolution)		
--	---	--	--