DIATHEMATIKON PROGRAMMA
CROSS-THEMATIC CURRICULUM FRAMEWORK
FOR PHYSICS AND CHEMISTRY

1. Teaching/learning aim

The aim of teaching Physics and Chemistry is described in the DP of Natural Sciences. Pupils studying Physics and Chemistry should be introduced to contemporary ideas and topics from the fields of Physics and Chemistry adapted to their intellectual ability and interests according to grade level, and not at the expense of scientific validity.

The teacher should make worthy use of recent cognitive psychology and educational research findings in order to help pupils through suitable activities do the following:

- understand the weaknesses of their views regarding the interpretation of diverse phenomena;
- build and use scientific models to describe, interpret and predict certain physical or chemical phenomena and processes.

The achievement of the above aims can undoubtedly be facilitated by the use of new educational technologies. Modern pedagogical tools (educational software, the Internet, systems of synchronous reception and projection of measurements) enhance student ability to collect, analyze, visualize, model and report data. With their active participation the students will therefore be able to understand basic principles and laws of Physics and Chemistry.

Educational processes differ as to the level of abstraction they demand. For example, explaining macroscopic phenomena using terms borrowed from microcosm and applying mathematical formalism demand a relatively higher degree of abstraction as compared to the experimentation and building of physical models. Educational processes demanding a high degree of abstraction should be gradually introduced and explored more extensively in more advanced grades.

Whenever it is considered appropriate, the subject matter should be developed in a spiral way and on the basis of student age, cognitive level and inductive and deductive reasoning abilities.

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

In the proposed syllabus special emphasis is put on:

- the common methodological approach followed in Physics and Chemistry;
- the common principles underlying physical and chemical phenomena.

More specifically, the adoption of new teaching approaches is proposed, based on the following content guiding principles:

- Structure of matter
- Energy, principles of conservation of energy and momentum and interactions between particles
- Systems (defining a system to be studied, its structural characteristics and properties e.g. cell, plant, ecosystem, atom, molecule, crystal).

I. Primary school

Physics-Chemistry

Grade	Content Guiding Principles	General Goals (Knowledge, skills, attitudes and values)	Indicative Fundamental Cross-thematic Concepts
1st	**Position and motion of bodies**	**Pupils should:** be introduced to the concept of the body position in relation to other bodies; be introduced to the concept of the motion of bodies as a change in their position.	**Change** **Space**
	Man and time	realize the time sequence of events happening in their families.	**Change**
		be introduced to the concept of time period through everyday life examples.	**Time**
	Electric power	realize the usefulness of electric power in everyday life; develop an interest in energy saving.	**Interaction**

	States of matter in which bodies (solids, liquids, gases) can be found and materials of which bodies are made	recognize solids, liquids and gases in their environment; recognize materials that certain objects in their environment are made of.	**System**
	Properties of sound	understand a. how sound is produced and b. the properties of sound.	**Interaction**
	The sun as an instrument for orientation and as a heat and light source	relate the four cardinal points to the sun's movement in the sky; relate sun's positioning in the sky to the succession of day and night; understand positive and negative effects of solar radiation.	**System** **Change**
2nd	**Materials and their properties** **Changes of state**	become familiar with the basic properties of solids and liquids (e.g. texture, color, shape).	**System**
	The cycle of water in nature	determine the relation between the states of water and weather conditions; determine the relation between weather conditions and seasonal changes, geographical positioning and living conditions.	**Interaction** **System** **Change**
	The cycle of life and time	relate time to life stages and family changes; learn how to measure time.	**Change** **Space** **Time**

	Water and wind energy	understand the importance of wind energy and water energy as alternative forms of energy which are friendly to the environment.	**Interaction System Change**
3rd	**Food-Converting and saving energy**	understand that food and fuel work as stored energy; relate energy conversion to interdependence of various living organisms.	**System Change**
4th	**Forming and separating mixtures**	form simple mixtures and separate them into their constituents/substances using simple methods.	**System Interdependence**
	Temperature–Heat–Changing states of matter	realize that body temperature is a physical quantity which describes objectively how hot or cold a body is; relate changes in states of matter to heat transfer.	**System Change Measurement**
	Air–The Earth's atmosphere	realize the existence of air.	**System**
	Light–transparent, opaque bodies	recognize transparent and opaque bodies in their environment.	**Interaction**
5th	**Bodies and structure of matter**	realize that material bodies have common properties (mass, volume, density); become familiar with the fact that macroscopic properties of matter can be described in a consistent way by referring to the basic constituents of matter, that is the atoms and molecules; ascribe the great variety of matter to the	**Dimension System Change Atom**

		property of atoms to form, through the interaction between them, different kinds of molecules; describe electrical phenomena in a consistent way by referring to the atomic structure.	
	Motion and forces	recognize motion as one of the main properties of bodies; describe the motion of known objects define forces on the basis of their results and describe the way in which they are applied.	**Interaction** **Change**
	Energy and its converted forms	make links between changes occurring in nature and energy conversion; realize that energy is conserved when it is transferred, converted or stored; realize the importance of energy efficiency and of renewable forms of energy for the environment.	**System** **Interaction** **Change** **Culture**
	Bodies (Acids-bases-salts-oxides)	recognize oxides and bases from their properties; be informed about the biological and technological applications of acids, bases and salts along with their harmful effects caused by irrational use.	**System** **Change** **Interaction**
6th	**Energy and its sources**	be introduced to the main forms of energy;	**Change** **Interaction** **System**

		realize that energy can be transformed from one form into another and can be stored; become familiar with the main modern sources of energy and understand that their rational use solves energy problems.	**Culture**
	Electromagnetism	realize that the relationship between electricity and magnetism is a process of energy transformation; appreciate the contribution of electromagnetism to the advancement of technology.	**Interaction** **Unit–Set** **Change** **Culture**
	Heat	recognize ways of heat transfer and relate them to the states of matter; understand the applications of heat transfer in every day activities.	**Interaction** **System** **Change**

II. Junior High school

A. Physics

Grade	Content Guiding Principles	General goals (Knowledge, skills, attitudes and values)	Indicative Fundamental Cross-thematic Concepts
2nd	**Motion**	**Pupils should:** recognize motion as one of the main properties of matter;	**Space–Time** **Change**

		describe relative motion; become familiar with and use concepts used to describe the motion of particles.	**System**
	Force-Pressure	relate change of motion to the concept of application of force; relate force to interaction; learn about conditions leading to motion or resting of bodies; become familiar with and exploit concepts used for the description of fluids (liquids, gases) in equilibrium.	**Interaction**
	Work-Energy	relate changes occurring in nature to energy transfer or transformation, in order to be able to describe in a consistent way chemical and biological phenomena; understand that energy manifests itself in different forms and that it is conserved.	**System** **Interaction** **Change**
	Heat	relate energy conservation during transformation or transfer to its downgrading, so that they become aware of the essence of the energy issue; realize that understanding the microscopic structure of matter leads to consistently interpreting its macroscopic behavior and thus conclude that matter is structured at different levels;	**System** **Interaction** **Change** **Culture**

		understand that heat is a form of energy and that it can be transformed into other forms (e.g. kinetic energy). Relate energy transformations to technology products through examples (e.g. steam engine, internal combustion engine) along with environmental issues (e.g. the greenhouse effect). Thus, they will be able to realize the significant contribution of the concept of heat to the development of human civilization; recognize thermal phenomena (thermal expansion, change of state, heat transfer) and interpret them in a simple by applying a model based on microscopic structure of matter; relate heat transferred to materials to change of temperature.	
3rd	**Electricity– Simple electric circuits**	become familiar with the concept of interaction from a distance and the concepts applying to electric fields; use a model to describe the structure of matter so that they can interpret electrical phenomena; understand the basic laws applying to simple circuits; understand the relationship of electric energy to other forms of energy.	**System** **Change** **Interaction** **Communication** **Culture**

	Oscillations-Waves-Acoustics	relate wave to propagation of energy; recognize the mechanism of propagation of a mechanical disturbance in a material and describe the characteristics of propagation; recognize and describe the characteristic properties of sound; relate sound wave to energy transfer.	**Change** **Interaction** **System** **Culture**
	Optics	understand through examples that light transfers energy; understand the basic principles of the geometric optics so that they can explain reflection and refraction phenomena and how shadows are formed; describe in a simple way the arrangement of elementary optical systems and recognize their applications in everyday life.	**Interaction** **Change**
	Nucleus and Nuclear phenomena	recognize the structure of the nucleus of atoms; relate the interaction force between nucleus components to nuclear energy; recognize the difference in magnitude between chemical and nuclear energy and relate it to a possible solution of the energy problem; Be informed about the harmful effects of nuclear energy on living organisms.	**Interaction** **System** **Culture** **Change**

B. Chemistry

Grade	Content Guiding Principles	General Goals (Knowledge, skills, attitudes and values)	Indicative Fundamental Cross-thematic Concepts
2nd	**Introduction to Chemistry** **What is chemistry and why we study it** **States of matter** **Physical properties of materials**	**Pupils should:** realize that knowledge of chemistry and its applications constitute cultural goods; realize that the irrational application of chemical knowledge can be harmful to human life and the environment; explore the physical properties of materials.	**Interaction** **Change** **Culture** **System** **Communication** **Similarity-Difference**
	From water to atom–from macrocosm to microcosm **Water in life, in the natural environment and in the Chemistry lab** **Chemical changes, atoms, molecules and ions** **Chemical elements**	appreciate water as a fundamental element creating and preserving life; recognize that water supply sufficiency is conducive to life quality improvement; suggest measures against water pollution and for the rational use of water resources; relate chemical phenomena in their environment to entities and concepts of the microcosm;	**Interaction** **Change** **Culture** **System** **Similarity–Difference** **Unit–Set** **Dimension** **Communication**

	and compounds **Chemical equations**	recognize that information coding facilitates human communication.	
	The atmosphere **Air composition** **Oxygen** **Carbon dioxide** **Air pollution**	relate air composition to life preservation; suggest ways to prevent imbalance in the ecosystem caused by air pollution; realize the biological, environmental and technological importance of combustion/oxidation.	**Interaction** **Change** **Unit–Set** **System** **Similarity–Difference** **Culture**
	Soil and sub-soil **Soil pollution**	make correlations between soil and sub-soil and life, development and economy; suggest ways to prevent imbalance in the ecosystem caused by soil pollution.	**Change** **System** **Culture**
3rd	**Acids, bases and salts** **Oxides, bases, neutralization, pH** **Applications of oxides, bases and salts in everyday life**	understand the applications of acids, bases and salts in everyday life; describe the biological and technological applications of acids and bases; suggest measures to protect the environment from the unwise use of acids, bases and salts.	**Interaction** **Change** **Similarity–Difference** **System** **Culture**
	Classification of elements-elements of special interest **The periodic table**	make connections between properties of elements and their position in the periodic table; recognize the properties of elements that	**Communication** **Similarity–Difference** **System**

	Alkali, halogens, carbon and silicon	are essential to technological development and the improvement of life quality.	**Interaction** **Change** **Culture** **Unit-Set**
	Chemistry of carbon **Hydrocarbons and oil** **Carbon compounds and life**	understand the important role of carbon compounds in everyday life; suggest measures against the irrational use of oil and natural gas; appraise how significant nutritive substances are for body development and health.	**Interaction** **Change** **Similarity–Difference** **Culture** **Unit-Set**