



European Schools

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Biology Syllabus – S6-S7

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¹ The syllabus was updated following the definitive entry into force of the Biology syllabus 4th and 5th Year (2 periods) (2011-01-D-71-en-2)

INTRODUCTION TO THE 2 PERIOD BIOLOGY PROGRAMME (BIO2) YEARS 6 AND 7

AIMS AND OBJECTIVES

1. *AIMS*

- a) To put biology into a social context: integrating ethical, cultural and technological issues.
- b) To stimulate a respect for the environment and highlight our responsibility for the environment. To show the relationship between us and our environment.
- c) To show the importance of the scientific method in the study of biology and show the connection between biology and other disciplines.
- d) To develop objectivity and critical analysis.
- e) Prepare students for further studies in scientific subjects (e.g. Biology, Biochemistry, Microbiology, Biotechnology, Medicine, Agriculture, Protection of the Environment, etc.) or in other fields that require an understanding of biological principles (e.g. journalism, law, psychology, etc.).

2. *OBJECTIVES*

- a) This course was originally designed for students with a literary, linguistic or artistic bias in their studies, who have an obligation to follow at least one scientific subject up to the baccalaureate. This said it must be noted that frequently students from the scientific stream choose this course as a complement and so the course must be sufficiently flexible for the teacher to adjust the level to fit the group of students.
- b) The content of this course has been designed to allow the teacher to treat some important and interesting problems in depth.
- c) To develop in the students the ability to express their ideas using a scientific vocabulary in written and oral work.
- d) To show that some biological themes can be dealt with in conjunction with other subjects such as philosophy.

3. *SKILLS*

- a) To be able to transfer knowledge from one situation to another.
- b) To be able to understand articles from newspapers and scientific journals and be able to extract the important points.
- c) To be able to correctly follow both oral and written instructions.
- d) To be able to make precise observations and to accurately record results.
- e) To be able to write a laboratory report.

4. **OUTLINE OF THE COURSE**

In year 6

- 6.1 Nutrition: composition and role of nutrients, diets and food preservation.
- 6.2 Health: diseases, transmission and defence.
- 6.3 The relation between Man and his Environment: nerves, hormones, behaviour, action of medicines and drugs.
- 6.4 The impact of Man on Nature: treatment and recycling of waste, biodiversity, atmospheric pollution, water purification.

In year 7

- 7.1 The cell: evolution and structure
- 7.2 Genetics: classical, molecular, and human.
- 7.3 Evolution: evidence, theories and evolution of Man

5. **MINIMUM TIME ALLOCATIONS**

In year 6

2 to 3 weeks for each of the topics chosen by the teacher.

In year 7

	TOPIC	TIME
1.1	Evolution of the cell	2 weeks
1.2	Cell structure	4 weeks
2.1	Molecular genetics	5 weeks
2.2	Classical genetics	3 weeks
2.3	Human genetics	3 weeks
3.1	Evidence for evolution	3 weeks
3.2	Theories of evolution	3 weeks
3.3	Evolution of Man	2 weeks
	TOTAL	25 weeks

6. **EVALUATION**

Marks should take into account:

- a) The quality of oral participation during class discussions and all personal work
- b) Written exams (B mark), the number and length of which are fixed by the rules of the European Baccalaureate
- c) Written exams must test:
 - a student's knowledge of core material.
 - a student's understanding of basic concepts.
 - a student's ability to use information from the course in new situations
- d) The choice of questions and the marking scheme must be such that an average student who has worked well can obtain at least a pass mark. There should not be an over-emphasis on rote learning.

ANNEX

Guidelines for the making of questions for written tests.

- a) Questions should be well balanced, that is should not demand too much rote learning nor require the solving of unseen, overcomplicated problems. They should be based on the understanding of biological principles and the learning of basic biological facts.
- b) The above balance should enable an average biology student who works well to easily obtain a 6 or a higher mark with extra effort.
- c) Each question should have a section to test basic knowledge and a section to test understanding and ability to use knowledge so that the more able students can distinguish themselves by obtaining a higher mark.

Guidelines for the making of oral questions for the baccalaureate examination.

- a) The examinations will normally cover the year 7 syllabus, but will also test knowledge gained in previous years, especially year 6.
- b) It is recommended that each question has parts drawn from 2 of the 3 core areas of the 7th year syllabus, but will also test knowledge gained in previous years, especially year 6.

Identifiable elements to be included in written questions

The ideas outlined below and the examples given are adapted specifically to testing in biology even though the principles are more general.

- a) Basic knowledge (rote learning)

Name organs, structures in a diagram or present general outlines of basic processes.

Examples:

- Label a diagram.
- Define a biological term

- b) Understanding and use of knowledge

A student should be able to recall information from different parts of the course(s) and be able to put the information together to draw new conclusions.

Example:

- State the relationship between the structure and function of a mitochondrion

- c) Resolving biology problems

A student should be able to resolve problems from the information supplied with the question.

Examples:

- Solve genetics problems.
- Analysis of experimental data.

BIOLOGY- 2 PERIODS (BIO2) - 6TH YEAR - COMPULSORY COURSE

MAN AND HIS ENVIRONMENT

The teacher must cover at least 10 of the 16 topics proposed in the first column.

TOPIC	CORE	SUPPLEMENT
6-1. Nutrition. 6-1.1. Food composition. 6-1.2. Role of different food components. 6-1.3. Food and health. 6-1.4. Making and preserving food.	Carbohydrates, fats, proteins, vitamins, minerals, water. Energy, growth, importance of vitamins and minerals. Balanced diets, vegetarian diets. Dietary problems: anorexia, malnutrition, vitamin & mineral deficiency. Disorders from over eating. Processing and conserving techniques.	Lab: food tests. Food chains, energy flow. Meeting with dietician. Cholesterol, arteriosclerosis. Visit to a food industry company.
6-2. Disease. 6-2.1. Pathogens. 6-2.2. Transmission of disease. 6-2.3. Non-specific defence. 6-2.4. Specific defence.	Bacteria, viruses and other parasites. Parasitic worms, insect vectors, airborne and food-borne infections, contagious diseases. Natural barrier to infection. Coagulation. Phagocytosis. Humoral and cellular reactions of the immune system.	Testing for infection. Allergic reactions.
6-3. Interaction between Man and environment 6-3.1. Nerves. 6-3.2. Hormones. 6-3.3. Behaviour. 6-3.4. Effect of chemicals on the nervous system.	Nerve cell, synapse, impulse transmission. Hormone action. Elements of animal behaviour and human behaviour. Medicines and drugs.	Diseases of nervous system: Alzheimer, Parkinson's, MS, etc. e.g. control of blood sugar level. Meeting with a sports doctor. Relationship between animal and human behaviour. Possible collaboration with the philosophy course. Meeting with specialists (psychologist, police, doctor, ex-drug addict, etc.)

6-4. Impact of Man on Nature.		
6-4.1. Treatment and recycling of waste.	Types of waste, sorting, adding value, stocking, incineration, making compost.	Visit to a recycling centre.
6-4.2. Biodiversity.	Plant and animal biodiversity. Species in danger of extinction. Maintaining biodiversity	Visits to a botanical garden and zoo.
6-4.3. Atmospheric pollution.	Gases of the atmosphere. Atmospheric pollutants. Acid rain. Greenhouse effect. Ozone.	
6-4.4. Water purification.	Production and importance of drinking water. Sewage treatment.	Visit to a sewage farm.

BIOLOGY- 2 PERIODS (BIO2) - 7TH YEAR - COMPULSORY COURSE

THE EVOLUTION OF LIFE

TOPIC		CORE	SUPPLEMENT
7-1.	The cell.	Synthesis of the first simple organic molecules and macromolecules. Prokaryotes, eukaryotes. Endosymbiotic theory. Evolution of heterotrophs and autotrophs.	Visit to an electron microscope. Study of electron micrographs.
7-1.1.	Evolution of the cell.		
7-1.2.	Cell structure.	Ultrastructure of a eukaryotic cell. Functions of organelles studied.	
7-2.	Genetics.	Structure of chromosome, structure and replication of DNA, mitosis, meiosis, RNA, protein synthesis, gene action, genetic engineering.	Discussion of press articles.
7-2.1.	Molecular Genetics.		
7-2.2.	Classical Genetics.	Mendel. Chromosome theory, linkage, crossing-over, chromosome maps.	Visit to a human genetics laboratory
7-2.3.	Human Genetics.	Methods of study: genealogical trees, twin studies, cytogenetic studies (karyotyping) and the establishment of chromosome maps, amniocentesis. Hereditary diseases due to gene mutations, chromosome mutations, numeric chromosome mutations (genome mutations). Sex-linked disorders: haemophilia, colour-blindness	
7-3.	Evolution.	Palaeontology, anatomy, biochemistry, embryology, biogeography and taxonomy.	Visit to a natural history museum.
7-3.1.	Evidence.		
7-3.2.	Theories.	Lamarckism, Darwinism. Neo-Darwinism (mutation, recombination, natural selection, speciation).	
7-3.3.	Evolution of Man.	Comparison of Man with another primate. Outline of the phylogenetic tree of Man.	

INTRODUCTION TO THE 4 PERIOD BIOLOGY COURSE

YEARS 6 AND 7

1. INTRODUCTION

a. This course is designed to prepare students for a variety of higher studies in biological and related subjects. These courses include;

Biological sciences;

biology, biochemistry, biotechnology, genetics, microbiology, marine biology, etc.

Medical sciences;

medicine, pharmacology, physiotherapy, veterinary science, dentistry, etc.

Environmental sciences;

agriculture, ecology, forestry, etc.

For other courses such as psychology, journalism and law, biology 4 will provide useful skills and background knowledge.

b. This course emphasises the application of the scientific method to the study of biological processes. Principles from experimental sciences are used widely throughout the course.

c. The course reflects the modern face of biology and the underlying importance of molecular biology and ecology is stressed in all of the main themes. This is a dynamic and expanding field and teachers should try to reflect this in their teaching. At the same time traditional aspects of the subjects have their place in the course.

d. The course stresses the importance of biological concepts in everyday life.

2. SUGGESTED METHODS FOR TEACHING THE COURSE

It is suggested that a variety of teaching approaches are used. These can include;

- practical work
- lectures
- use of audio visual materials
- use of computers e.g. data analysis by spreadsheets, simulations, information gathering from CD ROMs and the internet
- guided individual study
- seminars and discussions
- talks by students
- use of media articles
- visits to research institutes, museums, exhibitions

3. SKILLS

a. To be able to transfer knowledge from one situation to another.

b. To be able to understand articles from newspapers and scientific journals and to be able to extract the important points.

- c. To be able to follow both written and oral instructions.
- d. To be able to make precise observations and to accurately record results.
- e. To be able to analyse and interpret data.
- f. To be able to communicate effectively in written and oral reports.

4. COURSE CONTENT

Below is a list of the main themes and suggested amount of teaching time for each one. The total amount of teaching time shown for the course is a minimum and allows teachers some flexibility in developing topics that interest them and their students to a greater depth.

YEAR 6 BIOLOGY COURSE

NUMBER	TOPIC	TIME
6.1.1	Composition of living things	5 weeks
6.1.2	Enzymes (including all practical work)	3 weeks
6.1.3.1	Ultrastructure of the cell	3 weeks
6.1.3.2	Excitable cells	5 weeks
6.2.1	Neuro-hormonal regulation	2 week
6.2.2	Immunology	4 weeks
6.3	Animal behaviour	3 weeks
	Total	25 weeks

YEAR 7 BIOLOGY COURSE

NUMBER	TOPIC	TIME
7.1.1	Membranes and transport of substances	3 weeks
7.1.2	Energy fixation, synthesis of complex substances	3 weeks
7.1.3	Release of energy	3 weeks
7.2.1	Classical genetics	3 weeks
7.2.2	Molecular genetics	3 weeks
7.2.3	Mutations	1 week
7.2.4	Human genetics	2 weeks
7.3.1	Evidence for evolution	3 weeks
7.3.2	The origin of life	1 week
7.3.3	The theory of evolution	2 weeks
7.3.4	Human evolution	1 week
	Total	25 weeks

5. *EVALUATION*

YEAR 6

An A mark is awarded in each semester. It should be arrived at using the following forms of assessment;

- participation in class
- short tests
- written reports
- lab work and reports
- short talks

In addition a B mark is awarded in each semester which is the result of a semester examination (duration 3 teaching periods). The precise format of the examination is at the discretion of the teacher but should have the following components;

- knowledge
- application of knowledge
- analysis and interpretation

YEAR 7

The A mark for each semester should be awarded in the same way as for year 6.

There is one examination at the end of the first semester (the Prebac).

Students can also choose to sit the written or the oral examination in the baccalaureate.

GUIDELINES FOR THE SETTING OF WRITTEN BACCALAUREATE QUESTIONS

- a. The examinations will normally cover the year 7 syllabus, but will also test knowledge gained in previous years, especially year 6.
- b. To test basic knowledge, Eurobio diagrams should be used. For analysis and interpretation, other materials can be used but all of the relevant information should be provided to allow candidates to attempt the question.
- c. Questions should be set so that there is a progression of difficulty. Too many marks should not be given to the most difficult part of the question.
- d. Questions should not be set on too limited a part of the syllabus.
- e. The presentation of the questions should follow the guidelines laid down by the inspectors.
- f. Translations into different languages must scrupulously follow the sense of a question.

ORAL EXAMINATIONS

- a. The examinations will normally cover the year 7 syllabus, but will also test knowledge gained in previous years, especially year 6.
- b. It is recommended that each question has parts drawn from two of the three main sections of the 7th syllabus, (i.e. cytology, genetics and evolution), but will also test knowledge gained in previous years, especially year 6.
- c. Questions should test
- knowledge
 - application of knowledge
 - analysis and interpretation

Some gradation of difficulty should be included.

Biology 4 periods Year 6

TOPIC	CORE	SUPPLEMENT
<p>6.1. Cytology.</p> <p>6.1.1. Composition of living things.</p>	<p>The chemical composition of the cell: water, mineral salts, proteins, lipids, carbohydrates (carbon chains and functional groups of organic substances), RNA and DNA (model of Watson and Crick, nitrogenous bases represented by symbols).</p> <p>The role of chemicals found in the cell.</p>	
<p>6.1.2. Enzymes.</p>	<p>The role of catalysts.</p> <p>The structure of enzymes: protein, apoenzyme-coenzyme.</p> <p>Model of enzyme action: active site, enzyme-substrate complex, lock and key model, specificity.</p> <p>Factors that influence enzyme action: activation, inhibition, temperature, concentration, pH.</p>	
<p>6.1.3 The cell.</p> <p>6.1.3.1 Ultrastructure.</p>	<p>Ultracentrifugation, radioactive labelling and autoradiography, chromatography and electrophoresis.</p> <p>Structure et function of cellular organelles: unit membrane (fluid-mosaic model). Endoplasmic reticulum, ribosomes, microtubules, centrioles, Golgi apparatus, lysosomes, nucleus, mitochondria, plastids.</p> <p>Procaryotes et eucaryotes.</p> <p>Animal cell and plant cell.</p>	<p>This should be limited to a succinct revision of the functions of the organelles.</p>
<p>6.1.3.2 Excitable cells.</p>	<p>The nerve cell.</p> <p>Stimuli and perception, sense organs.</p> <p>Structure of neurones and synapses</p> <p>Physical and chemical processes taking place in the neurones and synapses: resting potential, action potential, saltatory conduction of impulse, threshold value, all-or-nothing principal, passage of the impulse through the synapse.</p> <p>The muscle cell.</p> <p>Ultrastructure of the muscle cell.</p> <p>Muscular contraction.</p>	<p>Limited to 2 sense organs.</p> <p>Diffusion and active transport.</p>

Biology 4 periods Year 6

TOPIC	CORE	SUPPLEMENT
6.2 Internal regulation. 6.2.1 Nervous and hormonal regulation (homeostasis).	An example of homeostatic regulation.	e.g. heartbeat, blood sugar concentration, body temperature, concentration of respiratory gases
6.2.2 The bodies defence.	Distinguishing between self and non-self: blood transfusions (ABO), grafting and transplants (MHC/HLA), types of antigens (epitopes). The immune system: cells of the immune system, origin and maturation, characteristics of lymphocyte receptors, (membrane bound antibodies of B lymphocytes, T lymphocyte receptors). The immune response: aspects of non- specific response (inflammation, phagocytosis), aspects of specific response, clonal selection, antibody production and memory cells.	Immune system problems (allergies, autoimmune disorders, immunological deficiencies) Treatments (vaccinations, bone marrow grafts).
6.3 Major characteristics of human and animal behaviour	An outline study of two paragraphs, 1 from group A and 1 from group B: A - Innate behaviour (reflex action, instinct, displacement activity, vacuum activity) and learned behaviour (conditioned reflex, imprinting, trial-and-error learning, insight). - Social behaviour (releasing stimuli, territorial behaviour, aggression, mother-and-child relationship, sexual behaviour) B - Management of water resources - Recycling and treatment of waste.	Pupil's reports.

Biology 4 periods Year 7

TOPIC	CORE	SUPPLEMENT
<p>7.1. Cytology.</p> <p>7.1.1 Membranes and cellular exchanges</p>	<p>Fluid-mosaic model of the membrane (revision)</p> <p>Diffusion, facilitated diffusion and osmosis (qualitative study)</p> <p>active transport across the membrane, pinocytosis, phagocytosis, exocytosis.</p>	
<p>7.1.2 Energy fixation and formation of organic molecules</p>	<p>Relationship between structure and function of chloroplasts.</p> <p>Factors influencing the rate of photosynthesis: concentration of CO₂ temperature, intensity and wavelength of light.</p> <p>Light reactions: photolysis of water, Hill reaction, photophosphorylation (chemiosmotic theory), formation of NADPH₂.</p> <p>Dark reaction (Calvin cycle): CO₂ fixation and synthesis of glucose (C₃ cycle).</p> <p>Overall equation of photosynthesis.</p>	<p>Revision of the structure of a leaf.</p> <p>Cycle C₄, photorespiration.</p>
<p>7.1.3 Energy release and the breakdown of organic molecules.</p>	<p>Relationship between structure and function of mitochondria.</p> <p>Cellular respiration: glycolysis, CoA, Krebs cycle, respiratory chain, formation of ATP (chemiosmotic theory).</p> <p>Fermentation (anaerobic respiration): alcoholic fermentation and lactic acid fermentation; comparison with aerobic respiration</p> <p>Overall equations of aerobic and anaerobic respiration</p> <p>Role of ATP and comparison of the gain of ATP by aerobic respiration and by fermentation.</p> <p>The importance of photosynthesis, respiration and fermentation in the cycles of matter and energy</p>	

Biology 4 periods Year 7

TOPIC	CORE	SUPPLEMENT
<p>7.2. Genetics.</p> <p>7.2.1. Classical genetics.</p>	<p>Chromosome theory, sexlinkage, linkage, crossing-over, chromosome mapping.</p> <p>Multiple alleles, multiple genes (qualitative study), epistasis.</p>	<p>Revision of 5th year genetics.</p>
<p>7.2.2. Molecular genetics.</p>	<p>DNA replication.</p> <p>One gene - one polypeptide hypothesis.</p> <p>The biosynthesis of proteins: genetic code transcription (pro- and eukaryote), translation.</p> <p>Fate of these proteins in a eukaryote.</p> <p>Gene regulation (Jacob and Monod model)</p> <p>Genetic manipulation: the transfer of a gene.</p>	<p>Revision of the structure of nucleic acids.</p> <p>Practical applications of genetic engineering: the creation of transgenic animals and plants, genetic fingerprinting.</p> <p>Tools of genetic manipulation (restriction enzymes, DNA ligase, gel electrophoresis, PCR).</p> <p>Bioethics.</p>
<p>7.2.3. Mutations.</p>	<p>Gene mutations.</p> <p>Chromosome mutations: deletions, inversions, translocations, duplications.</p> <p>Genome mutations: aneuploidy, polyploidy</p> <p>Mutagenic agents.</p>	
<p>7.2.4. Human heredity.</p>	<p>Methods of study: family trees, twin studies, cytogenetic studies</p> <p>Hereditary diseases resulting from gene and chromosome mutations</p> <p>Sex linked diseases.</p>	

Biology 4 periods Year 7

TOPIC	CORE	SUPPLEMENT
<p>7.3. Evolution.</p> <p>7.3.1. Evidence for evolution.</p>	<p>Palaeontology: fossilisation, Archaeopteryx, evolution of the horse.</p> <p>Comparative anatomy: homologous structures (forelimbs and circulatory systems of vertebrates, vestigial organs)</p> <p>Biochemical evidence: comparative serology in mammals, universality of protein synthesis and the use of ATP.</p> <p>Evidence from karyotypes.</p>	<p>Animal and plant classification: over view of the 5 kingdoms.</p> <p>Relative and absolute dating.</p> <p>Evidence from embryology.</p> <p>Evidence from biogeography.</p>
<p>7.3.2 Origin of life</p>	<p>Chemical evolution (Miller's experiment – importance and criticisms)</p> <p>Cell evolution (endosymbiotic theory).</p>	<p>Limit BAC questions to the endosymbiotic theory.</p>
<p>7.3.3 Theories of evolution.</p>	<p>Lamarckism and Darwinism.</p> <p>Neo-Darwinism (synthetic theory)</p> <p>The causes of genetic variability: mutation and recombination.</p> <p>Population genetics: random genetic drift, polymorphism, Hardy-Weinberg law.</p> <p>Natural selection: industrial melanism, convergence – analogous organs.</p> <p>Definition of a species. Allopatric speciation.</p>	
<p>7.3.4 Human evolution.</p>	<p>Comparison between Man, Australopithecines and the great apes: limbs, gait, stance, dentition, cranium, brain.</p>	