Schola Europaea

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Syllabus for Laboratory Biology – Complementary course

APPROVED BY THE JOINT TEACHING COMMITTEE ON 9 AND 10 FEBRUARY 2017 IN BRUSSELS

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on 1 September 2018 for S7

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on 1 September 2020 for S7

Syllabus – Laboratory Biology

1. General Objectives of the European Schools

The European Schools have the two objectives of providing formal education and of encouraging pupils' personal development in a wider social and cultural context. Formal education involves the acquisition of competences (knowledge, skills and attitudes) across a range of domains. Personal development takes place in a variety of spiritual, moral, social and cultural contexts. It involves an awareness of appropriate behaviour, an understanding of the environment in which pupils live, and a development of their individual identity.

These two objectives are nurtured in the context of an enhanced awareness of the richness of European culture. Awareness and experience of a shared European life should lead pupils towards a greater respect for the traditions of each individual country and region in Europe, while developing and preserving their own national identities.

The pupils of the European Schools are future citizens of Europe and the world. As such, they need a range of competences if they are to meet the challenges of a rapidly-changing world. In 2006 the European Council and European Parliament adopted a European Framework for Key Competences for Lifelong Learning. It identifies eight key competences which all individuals need for personal fulfilment and development, for active citizenship, for social inclusion and for employment:

1. *Communication in the mother tongue*
2. *Communication in foreign languages*
3. *Mathematical competence and basic competences in science and technology*
4. *Digital competence*
5. *Learning to learn*
6. *Social and civic competences*
7. *Sense of initiative and entrepreneurship*
8. *Cultural awareness and expression*

The European Schools' syllabuses seek to develop all of these key competences in the pupils.

2. Didactic Principles

The general **aim** of this course is to develop the **skills**, **knowledge** and **understanding** to carry out experiments, research and practical investigations. This will emphasise the principles and practice of investigative science and its communication. Learners will do this through investigation of scientific method, scientific literature and communication. Therefore, they will work with pilot studies, sampling, variables, experimental design including controls and reliability assurance. Evaluating background information, experimental design, data analysis and conclusions will focus on research and Scientific Ethics.

The collection of experimental data will provide an opportunity to develop planning and organising skills. Learners will research issues and apply scientific skills which will develop their scientific literacy.

The course covers the **key areas** of: scientific principles and process; experimentation; critical evaluation of scientific research.

Through this Course, learners will develop important skills, attitudes and attributes related to science, including: developing scientific and analytical thinking skills in a scientific context; developing understanding of scientific issues; and acquiring and applying knowledge and understanding of science. These skills enable learners to develop an informed and ethical view of complex issues.

Learners will be able to develop their written and oral communication and collaborative working skills and be able to apply critical thinking in new and unfamiliar contexts to solve problems. This will enable learners to become scientifically literate citizens, who are able to make rational decisions that are based on evidence and interpretation of scientific information.

The Course allows **flexibility**, **differentiation** and **personalisation** by offering choice within the key topics studied. The course content should be selected to allow learners to study key scientific concepts within situations of personal relevance, using up-to-date contexts and modern technology. Differentiation should take into account both the background of the learner and their learning expectations. Learners' creativity will be developed and encouraged through opportunities to generate new ideas when planning and designing investigations and practical, which they will carry out.

The order, nature and number of experiments is not fixed as there are many variables to be considered such as the availability of equipment and material, time of year etc.

As laboratory work requires considerable time the lab course should be timetabled as a double period and the last 2 periods of the day should be avoided to allow the continuation of experiments.

Entry to this course is dependent upon the student following the corresponding four period science course in years six and seven of secondary.

3. Learning Objectives

By the end of year seven pupils should be able to:

- Use scientific knowledge to analyse problems and apply it to new situations.
- Process and both, quantitatively and qualitatively, analyse scientific information/data from a variety of sources including scientific publications and media reports
- Plan and design biological experiments/investigations, using reference materials and including risk assessments, to test a hypothesis or to illustrate particular effects
- Identify potential hazards, assessing associated risks and applying appropriate control measures.
- Record detailed observations and collect data with precision and accuracy

- Produce, describe and analyse different kinds of graphs
- Draw valid conclusions and giving explanations supported by evidence/justification
- Critically evaluate experimental procedures by identifying sources of error, suggesting and implementing improvements
- Communicate clearly, using scientific vocabulary correctly. Demonstrate very good presentation skills.
- Work constructively in a team.
- Take account ethical considerations, as appropriate, in, for example, the use of living materials, human subjects and the conservation of natural habitats

4. Contents

The following are suggestions only and over the 2 years the teacher should try to include practicals from each of the Key Topics. The study of the history of science along with visits and links with higher education, industry research, institutes etc. are to be encouraged. Lab Bio teachers should liaise with other BI4 teachers to avoid repetition of experiments/activities and to identify key practicals to be covered by all BI4 classes/teachers. Links to scientific competitions, for example the ESSS are also appropriate activities. It is hoped that material will be made available on a O365 Lab Bio SharePoint in the future

Key Topics	Suggested areas/ideas for study
Scientific Method and techniques	· Design an experiment with controls, such as a laboratory investigation using an enzyme · Design and carry out a field observational study, such as an environmental transect · Write a method that can be followed by another investigator. Follow the method provided by another investigator · Design and carry out a scientific investigation over several weeks
Techniques and technology	· Centrifugation · Chromatography · Electrophoresis · PCR · ELISA
Biochemistry	· DNA extraction, origami model, sweet model · Enzymes e.g. synthesis, degradation, temperature, pH, inhibitors · Organic molecules e.g. identification, concentration, food tests, calorimetry etc.
Cell Biology	· Microscopy, observation and drawing of various specimens · Membranes and cellular exchange · Mitosis and Meiosis
Physiology and Anatomy	· Metabolism (photosynthesis, fermentation, respiration) · Dissections · Nervous system · Fitness · Immunology
Genetics	· Drosophila · Bacterial transformation · Cloning of plant tissue
Evolution	· Natural selection games/activities · Study of fossils and skulls · Computer simulations/activities · Human evolution
Behaviour	· Reaction times · Behavioural studies
Ecology	· Field studies

5. Assessment

Evidence can be drawn from a variety of sources and formats including participation, reports, projects (long term and research based) and presentations/communication skills etc.

Formal written long tests are not to be used for assessment of pupils in Lab Biology.

Suggested **assessment activities** for A and B marks.

An **A mark** is awarded for each semester and should be arrived at using some/all of the following:

- Observation of students during practical activities
  - Participation in class: individual and collaborative working skills, during and after practical activities
  - Attention to health and safety
  - Use of material and equipment

- Written reports*/Project reports/Lab books/Notes/Research/Worksheets etc.
  - Aims/Hypotheses
  - Procedures/methods
  - Presents results in an appropriate format
  - Draw appropriate conclusions
  - Makes accurate statements
  - Evaluation of experimental procedures

- Presentation skills

A **B mark** is awarded for each semester and should be arrived at using some/all of the following:

- Practical assessments
- Research and practical investigations
- Report on scientific literature and ethics
- Presentations e.g. Field trip/visit report

* Please refer to ‘Appendix 1. Suggested Assessment Criteria for Written Reports’

5.1. Attainment descriptors

	A (9.0-10 – Excellent)	**B** (8.0-8.9 – Very good)	**C** (7.0-7.9 – Good)	**D** (6.0-6.9 – Satisfactory)	**E** (5.0-5.9 – Sufficient)	**F** (3.0-4.9 – Failed/Weak)	**FX** (0-2.9 – Failed/Very Weak)
Data Collection and Analysis	Is capable of collecting data from a wide range of sources. Produces detailed explanations through critical analysis of complex data.	Is capable of collecting data from a wide range of sources. Analyses and explains complex data well.	Is capable of collecting data from a limited range sources Produces good analysis and explanations of data	Is capable of collecting data from a limited range sources Produces basic analysis and explanations of simple data	Is capable of collecting data from a single source. Given a structure can analyze and explain simple data	Has difficulties collecting appropriate data. Can use data only with significant guidance	Fails to collect data. Fails use data provided.
Experimental work	Formulates hypotheses, designs and carries out investigations using a wide range of techniques while being aware of ethical issues. Is capable of critically evaluating experimental procedures with no guidance.	Designs and carries out experiments using appropriate techniques, being aware of safety issues. Is capable of modifying experimental procedures with some guidance.	Follows a written procedure safely and makes and records observations, presenting them using different techniques.	Follows a written procedure safely and records observations.	Follows a written procedure safely and makes basic observations	Has difficulty following instructions without supervision.	Is not able to safely follow a written procedure.
Communication (oral and written)	Communicates logically and concisely using scientific vocabulary correctly. Demonstrates excellent presentation skills.	Communicates clearly using scientific vocabulary correctly. Demonstrates very good presentation skills.	Communicates clearly most of the time using scientific vocabulary correctly. Demonstrates good presentation skills.	Uses basic scientific vocabulary, and descriptions show some structure. Demonstrates satisfactory presentation skills.	Uses basic scientific vocabulary, but descriptions may lack structure or clarity. Demonstrates satisfactory presentation skills	Generally, produces descriptions that are insufficient or incomplete with a poor use of scientific vocabulary. Lacks acceptable presentation skills.	Has very poor communication and presentation skills.
Teamwork	Shows initiative – a team leader.	Works constructively in a team.	Works well in a team.	Works satisfactorily in a team.	and participates in team work.	Needs assistance when working in a team.	Does not work in a team.

6. Annexes

Appendix 1. Suggested Assessment Criteria for Written Reports

Summary of suggested assessment category and criteria for reports (where appropriate):

Presentation

- appropriate and informative title
- contents page and page numbers
- brief summary/abstract stating aims and findings
- references cited in text and listed in standard form
- report is clear and concise

Introduction

- clear statement of aims together with hypotheses/questions
- account of underlying science relevant to aims
- scientific terms/ideas are clear and at an appropriate depth
- scientific importance is explained/justified

Procedures

- appropriate to aims
- clear description with enough detail to allow repetition
- include appropriate controls and adequate control of variables
- adequate replicates and sample size
- appropriate complexity of methods/inputs/outputs
- creativity and originality
- appropriate accuracy or modifications to improve accuracy

Results

- relevant to aims
- data recorded within limits of accuracy of measurement
- data presented summarise overall results
- adequate quality, including headings/units/scales/labels/clarity
- brief description of trends and patterns in tables or graphs

Discussion

Conclusion:

- conclusions relate to aims
- conclusions are valid for results obtained

Evaluation of procedures *includes comment as appropriate on:*

- accuracy/sources of error in measurement
- adequacy of replication/sampling adequacy of controls
- solutions to problems and modifications to procedures

Evaluation of results includes as appropriate:

- analysis and interpretation of results
- account taken of error/variation in replicates
- meaningful suggestions for further work
- critical and scientific discussion of significance of findings
- appropriate depth of scientific knowledge and understanding