Schola Europaea

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Pedagogical Development Unit

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Syllabus for Laboratory Chemistry – Complementary course – S6-S7

APPROVED BY THE JOINT TEACHING COMMITTEE AT ITS MEETING OF 12 AND 13 OCTOBER 2017 IN BRUSSELS

Entry into force on 1 September 2018 for S6
on 1 September 2019 for S7

Attainment descriptors: **on 1 September 2019 for S6**
on 1 September 2020 for S7

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. The ultimate aim of this course is that students can correctly design, carry out and report on an experiment.

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.

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 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.

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.

3. Learning Objectives

Laboratory skills

- The student is able to work independently and safely in a laboratory
- The student is able to recognize hazardous situations and act appropriately
- The student is aware of environmental issues and acts accordingly
- The student is able to carry out common laboratory procedures correctly

Experimental skills

- The student can follow written instructions
- The student can safely and correctly use a range of practical equipment and materials
- The student can plan an experiment, including working with dependent and independent variables
- The student can formulate a hypothesis
- The student can make accurate qualitative observations
- The student can make accurate quantitative measurements

Communication skills

- The student can work constructively as part of a team
- The student can present data accurately in the appropriate form (graphs, charts, drawings)
- The student can use appropriate software to process data
- The student can write a lab report (introduction, method & materials, conclusion, discussion, references)

Analytical skills

- The student can draw correct conclusions from experimental data
- The student can correctly assess the quality of data including estimating errors and commenting on experimental design

4. Contents

The teacher determines which experiments the student performs following these guidelines.

- It is recommended that the experiments are relevant to the subject syllabus.
- It is recommended that the student grow in independence during the course.
- In S7 a student should be able to design, carry out and report on a simple experiment.
- It is recommended that students perform both experiments that require qualitative observation and experiments that require quantitative measurement.
- It is recommended that students complete at least one preparation (making a chemical), including the isolation, and purification of the product.
- It is recommended that students complete at least one multi-stage experiment.
- Visits to and links with higher education, industry, research institutes etc. are encouraged.
- Links to scientific competitions, for example the ESSS are encouraged.
- Lab Chem teachers should liaise with other Chemistry teachers to avoid repetition of experiments/activities and to identify key practical's to be covered by all Lab Chemistry teachers.
- Sharing of material on Office 365 is encouraged.

Some idea for experiments

Extraction of natural products	• limonene, eugenol, caffine
Kinetic studies	• Determine the order of reaction with respect to a substance in a reaction. • Study the SN1, SN2 mechanisms • Show that spectator ions can influence the rate of reaction.
Equilibria studies	Determine the K_c for a reaction eg esterification. Fe^{2+} / SCN^-
Quantum Mechanics	• Use Spectrophotometry to study a reaction. • 'Cold light'
Chromatography	• Tlc • Column elution to separate components in mixtures. • Identification of metals in coins /amino acids.
Analysis techniques	• Other methods of performing titrations, eg back titration, thermometric titrations, analysis of Cu2+ content • melting point/boiling point determinations
Multi-faceted organic preparation	• Two step synthesis. • Extraction and identification of by-products • Extended purification, and identification of a product.
Identification of unknown substances	• Using simple test-tube tests to identify a range of inorganic compounds. • To identify unknown organic compounds

Acids and Bases	• Determine Kb • Study of polyacids, eg Phosphoric acid in colas, Carbonate acid reaction • Determine K_{ind}
Study Polymers	• Slime • Polymers based on milk, potatoes…
Chemistry and cooking	• Ice Cream • Agar gels
Extended investigations	• Conductivity measurements: Study of the parameters of a conductimetric cell, Af / BF, AF / BF ... • Investigate how the strength of an acid affects the order of reaction in eg M + H+ • Opened ended student choice investigation.

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 <u>not</u> to be used for assessment of pupils in Lab Chemistry!

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 based on the completion of a simple (but new) experiment with a short written report (two course periods).

* 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)
Analysis	Is capable of detailed and critical analysis and explanations of complex data.	Analyses and explains complex data well.	Produces good analysis and explanations of simple data.	Produces basic analysis and explanations of simple data.	Given a structure can analyse and explain simple data.	Can use data only with significant guidance.	Fails to use data adequately.
Experimental work	Formulates hypotheses, plans and carries out investigations using a wide range of techniques while being aware of ethical issues.	Plans and carries out experiments using appropriate techniques, being aware of safety issues.	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