Universitat Autònoma de Barcelona

2019/2020

Teaching Methods for Physics and Chemistry

Code: 42087
ECTS Credits: 27

Degree	Type	Year	Semester
4310486 Teaching in Secondary Schools, Vocational Training and Language Centres	OT	0	A

Contact

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Use of Languages

Principal working language: catalan (cat)

Teachers

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External teachers

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Prerequisites

No requierements

Objectives and Contextualisation

The aim of the course is to complete the knowledge of future science teachers of biology, geology, physics and chemistry graduates, engineers or graduates and bring them to the knowledge of science education and the specific teaching of each discipline.

It consists of two modules differentiated content:

- The additional training module that aims to complete the knowledge of biology, geology, physics and chemistry graduates, engineering graduates or future science teachers. It includes blocks of history of science and current events and training complements.

- The module specific teaching and teaching innovation and introduction to research aimed at training the future high school teacher that can teach the contents of the knowledge areas of biology and geology and physics and chemistry, integrating disciplinary knowledge and the teaching of science taking into account the knowledge of other areas such as epistemology, language and communication, psychology and pedagogy. Includes blocks introduction to didactics, the didactics of biology and geology and teaching innovation and introduction to research.

Competences

- "Design and conduct formal and no-formal activities that help make the center a place of participation and culture in the environment where it is located; develop the functions of mentoring and guiding students in a collaborative and coordinated manner; participate in the evaluation, research and innovation in teaching and learning"
- "Determine the curriculum that will be implanted in a school participating in the collective planning thereof; develop and implement both group and personalized teaching methodologies adapted to the diversity of students."
- Acquire strategies to encourage student effort and enhance their capacity to learn by himself and others, and develop thinking skills and decision-making to facilitate autonomy, confidence and personal initiative.
- Communicate effectively both verbally and non-verbally.
- Design and develop learning spaces with special attention to equity, education and emotional values, equal rights and opportunities for men and women, civic education and respect for human rights that facilitate life in society, decision making and building a sustainable future.
- Generate innovative and competitive professional activities and research.
- Interpret the different educational needs of students in order to propose the most appropriate educational activities.
- Know the curricular content of the matters relating to the appropriate teaching specialization and the body of didactic knowledge around the respective teaching and learning.
- Make effective use of integrated information and communications technology.
- Own the learning skills necessary to carry out continuous training, both in content and teaching specialty, as in the general aspects of teaching.
- Plan, develop and evaluate the teaching and learning process enhancing educational processes that facilitate the acquisition of the competences of the respective teachings, based on the level and previous training of students as well as the orientation of the same, both individually and in collaboration with other teachers and school professionals
- Search, obtain, process and communicate information (oral, printed, audiovisual, digital or multimedia), transform it into knowledge and apply it in the teaching and learning in their own areas of specialization.
- know the processes of interaction and communication in the classroom, mastering social skills and abilities necessary to encourage learning and coexistence in the classroom, and address problems of discipline and conflict resolution.

Learning Outcomes

1. Communicate effectively, both verbally and non-verbally.
2. Demonstrate knowledge and knows how to apply innovative teaching proposals in the Biology and Geology fields.
3. Demonstrate knowledge of contexts and situations in which they are used and the physics and chemistry that composen the curriculum of Compulsory Secondary Education and Baccalaureate apply, highlighting its functional character and analyzing his impact.
4. Demonstrate knowledge of cultural and educational value of physics and chemistry and the contents of these disciplines taught in Secondary Education and Baccalaureate, and integrate this content in the framework of science and culture.

5. Demonstrate knowledge of the curricula of physics and chemistry of this and Baccalaureate.
6. Demonstrate knowledge of the history and recent developments in physics and chemistry and his perspectives to convey a dynamic view of the same and make sense of the Physics and Chemistry School, highlighting the historical genesis of the knowledge of these sciences.
7. Demonstrate knowledge of the theoretical and practical developments in teaching and learning of Physics and Chemistry.
8. Design and develop learning spaces with special attention to equity, education and emotional values, equal rights and opportunities between men and women, civic education and human rights that facilitate life in society, decisions and building a sustainable future.
9. Generate innovative and competitive proposals for research and professional activities.
10. Identify and plan the resolution of educational situations that affect students with different abilities and different learning rates.
11. Identify problems relating to the teaching and learning of physics and chemistry and propose possible alternatives and solutions.
12. Interpret the different educational needs of students in order to propose the most appropriate educational activities.
13. Know the processes of interaction and communication in the classroom, mastering social skills and abilities necessary to encourage learning and coexistence in the classroom, addressing issues of discipline and conflict resolution.
14. Possess learning skills necessary to carry out continuous training in both content and didactics of physics and chemistry, as well as general aspects of teaching.
15. Search, obtain, process and communicate information (oral, printed, audiovisual, digital or multimedia) to transform it into knowledge and apply it in the teaching-learning materials specific to the specialization studied.
16. Select, use and develop materials for teaching physics and chemistry.
17. Transform the curriculum of physics and chemistry at sequences of learning activities and programes of work.
18. Understand the evaluation as an instrument of regulation and to encourage the effort, and meet and develop strategies and techniques for the evaluation of learning physics and chemistry.
19. Use information and communications technology and integrate them into the teaching and learning of physics and chemistry.

Content

The specific module of Physics and chemistry and its teaching is divided into 2 large blocks: Physics and Chemistry didactics and Complementary Training.

PHYSICS AND CHEMISTRY DIDACTICS

The block "Physics and chemistry didactics" is divided into 2 parts: "Learning and teaching Physics and Chemistry" (9cr) and "Teaching innovation and introduction to research in Physics and Chemistry didactics" (6cr).

Learning and teaching Physics and Chemistry (9cr)

Introduction to Science Education (3cr)

- Purpose of teaching science at ESO

- The teaching of science and development of scientific competence

- What is science? Reflections on the epistemology of science

- What science should be taught in school?

- Didactic models and preconceptions

- The learning cycle and activities

- Assessment and regulation of learning

Chemistry Didactics (3cr)

- Purposes of teaching chemistry.

- The great ideas of chemistry (substances "chemical species" chemical change, molecular-kinetic model). Identifying key curriculum models (model kinetic model atomicomolecular and atomic model classic). Selection and sequencing of content to teach.

- Scenarios and learning resources

- The teaching of chemistry in teaching and learning chemicalchange

- The water and ions dissolutions

- Electricity and chemical change

- Modeling, investigation and argumentation in school chemistry

- Laboratory work in Chemistry

Physics Didactics (3cr)

- The school physics models and key concepts: and because

- Ideas and ways of reasoning of the students in physics

- Modeling, school physics inquiry and argumentation

- Acts paradigmatic you real problems andcontroversy as socio-scientific contexts relevant to the teaching of physics.

- Using ICT Work and experimental physics

Teaching innovation and introduction to research in Physics and Chemistry didactics (6 cr)

Teaching innovation

- The curriculum. Learning objectives, programming and evaluation.

- Diversity of types of competence teaching units according to the approach: progressions, projects, inquiry, ABP, modelling etc.

- Contexts and knowledge transfer.

- The development of transversal skills: critical thinking, cognitive-linguistic, digital, self-regulation, etc.

Introduction to Physics and Chemistry Education Research

- Reflective practice: reflection on practice and its relationship to educational innovation

- The classroom observation: goals, models of observation and instruments

- Methodological bases for innovation and educational research

- Current trends in research in science education

COMPLEMENTARY TRAINING

The block "Complementary Training in Biology and Geology and Physics and Chemistry" is divided into 2 parts: History of Science and Fundamentals of biology, geology, phisics and chemistry.

History of Science (4cr)

Through critical analysis of authors and relevant episodes, this part is intended that the student acquire a basic historical master scientific culture.

1. Thinking mythical, natural thought. Reading: Aristotle and Galen
2. The Journey of the Almagest. Views: Copernicus
3. The mathematization of nature. Views: Galileo
4. The world system. Views: Newton
5. The two cultures. Readings: Frankenstein
6. The historical view of life. Readings: Darwin
7. Newtonian crisis. Readings: Einstein
8. The new atoms.Views: Curie
9. Individual, information and society. Views: Watson
10. Chaos, order and dinosaurs. Views: Crichton

In the first part of each session we will discuss and discuss the proposed texts for the topic that we will have exposed in the previous session. In the second part we will present a new theme and propose issues so you can read the text or texts proposed for the next session.

Fundamentals of Biology, Geology, Physics and Chemistry (6cr)

Work on fundamental contents of biology, geology, physics or chemistry to supplement the initial training of future teachers of physics and chemistry. Students will attend two disciplinary basis depending on their initial training. Students may attend different disciplinary courses depending on their previous formation. The contents to study are:

Fundamentals of Biology (3cr)

- The Chemistry of Life: Chemical components of the cell. Bioelements and organic molecules. Enzyme biological activity. Introduction to metabolism. Relationship between metabolism and nutrition.

-The Genetically modified organisms (GMOs): transgenic plants. Handling plant genome for transgene introduction. Examples.

- The cell: The prokaryotic cell and eukaryotic. structure and function of the organelle. Organizational models. Cellular division. Virus and bacteria.

- Basis of Inheritance: Classical Genetics. Mendel's laws. sex-linked inheritance. Identification of DNA as the carrier of genetic inheritance Humana (Human Genome). Alterations of the genome.

- Human body: General organization of the human body. Anatomy and physiology of the human body devices. endocrine sensory organs, nervous system and

- Origin of life. Biological Diversity. Fixity and evolutionism. Darwinian selection. Fossil hominids to the Homo Sapiens and Evolution of Man.

- Organisms and systems. Levels of ecological organization. Basic principles of ecology.

Fundamentals of Geology

- Geology as a science. The Earth as a complex system.

- Earth materials: rocks, rock cycle.

- Geology of Catalonia. Geological history and landforms. Field work in the area of the Sant Jaume stream between the towns of Olesa de Montserrat and Vacarisses.

- History ofthe Earth: strata, sedimentary structures, sedimentary environments, stratigraphic record, continuity and discontinuity, geological time, dating and fossils

- History of the Earth: geological maps, map elements, maps and geological sections, geological history.

- Earth materials: minerals, rock builders and resource base.

Interdisciplinar project linked to Fundamentals of Physics:

- Sun-Earth system.

- Internal structure and Earth changes: global tectonics, earthquakes, volcanoes, tectonic deformation and structures, landscape as an interaction between internal and external processes. Geological hazards.

Fundamentals of Physics

- Measurement and analysis

- How to determine the correlation between variables.

- The Multilog-Pro team and Multilab program.

- Examples of relations between position, velocity and acceleration.

- Forces and Motion

- The concept of force and their types.

- Examples of movements with and without friction. Useful use of frictional forces.

- The dynamic equilibrium: motion at constant speed.

- Energy view of the processes

- Energy conservation.

- Mechanisms of energy transfer and its relationship withthe power quality. Probabilistic interpretation of the Second Law of Thermodynamics.

- Electromagnetism

- Theelectric field and magnetic. Experimental determination of the field lines.

- An experiment on electromagnetic induction.

- Wave phenomena.

Fundamentals of Chemistry

- Pure substances and dissolutions. Chemical change.

Laboratory. Density measure. Saturated dissolution: crystallization. Visualisation of chemical change.

Discussion and exercises. Pure substances and mixtures. Dissolutions. Substances separation. Physical change and chemical change.

- Stoichiometry

Laboratory. Precipitation reaction. Filtration. Performance. Mass conservation in a chemical reaction.

Discussion and exercises. Atom and molecule. Mole concept. Chemical equation: levelling. Stoichiometric calculus.

- Heat of chemical reactions

Laboratory. Exothermic reaction. Endothermic reaction.

Discussion and exercices. Reaction heat. Inner energy and enthalpy. Calorimetry and stoichiometric calculus.

- Chemical kinetics.

Laboratory. Chemical reaction speed observation. Reaction speed dependence regarding temperature and reagents.

Discussion and exercises. Fast and slow reactions. Chemical reaction speed concept. Order of reaction and constant of reaction.

- Chemical balance and acid-base reactions

Laboratory. Observations of chemical balance in different reactions.

Discussion and exercises. Chemical balance concept. Balance constant (Kc or Kps). Dependence of K regarding temperature. Balance displacement.

Laboratory. pH measure of real samples and solutions.

Discussion and exercises. Acid-base reaction concept: H+ transfer. Ionization of water (Kw) and acid or base strength (Ka and Kb). pH scale. Acid-base Indicators.

- Redox reactions and batteries

Laboratory. Redox reactions observation.

Discussion and exercises. Redox reaction: electron transference. Semireactions and global reactions. Oxidant/ reduction power of substances.

Laboratory. Battery construction and electromotive force (FEM)

Discussion and exercises. Battery electrodes: cathode and anode. Polarity. Semireactions and global reaction of a battery. Ion movement and saline bridge. Fem Calculus from tabulated data (E^o).

Interdisciplinary Project of Biology and Chemistry

This is a transversal activity of "Fundamentals of Biology" and "Fundamentals of Chemistry", it is scheduled to be done in groups.

Interdisciplinary Project of Physics and Geology

This is a transversal activity of "Fundamentals of Physics" and "Fundamentals of Geology", it is scheduled to be done in groups.

Topics of current science (2cr)

Issues in the field of science with a high degree of social impact thatwill help the future teacher to promote discussion with high school students to arrive at a reasoned opinion on them.

The topics will be among the following:

- Science, money and politics

- Gender and Science

- Neuroscience and education: towards a new paradigm of learning processes.

- Ethnificate representations of alumni: from cultural essentialism to deficit perspectives.

Methodology

The hours indicated for each of the training activities are indicative and can be modified slightly depending on the schedule or the teaching needs.

In classroom activities, students will be proposed to work in small groups to promote the maximum participation of all students.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Assistència i participació a classes magistral, pràctiques de laboartori, sortides, etc. i al realització i avaluació de les activitats proposades	175.5	7.02	15, 1, 13, 3, 4, 5, 7, 2, 6, 8, 18, 9, 11, 10, 12, 14, 16, 17, 19
Type: Supervised			
Realització, revisió i avaluació dels treballs proposats (informes, estudis de cas, resolució de problemes, exposicions, pràctiques de laboratori, treballs de camp...	175.5	7.02	15, 1, 13, 3, 4, 5, 7, 2, 6, 8, 18, 9, 11, 10, 12, 14, 16, 17, 19
Type: Autonomous			
Anàlisi de lectures i propostes d'innovació didàctica, realització d'informes, disseny d'activitats, anàlisi i resolució de casos	324	12.96	15, 1, 13, 3, 4, 5, 7, 2, 6, 8, 18, 9, 11, 10, 12, 14, 16, 17, 19

Assessment

Evaluation criteria

The class attendance is mandatory. The student must attend a minimum of 80% of the full sessions of the module. Otherwise it will be considered "no show".

To pass the module Biology and Geology or Physics and Chemistry and its teaching is necessary to have passed each of the blocks of content and each of the themes that shape and can still be made independently

Summative evaluation of each of the themes of each block includes group activities and individual activities. To make media should take at least 4 of each of the planned activities to be evaluated and that teachers previously indicated.

Throughout the module part of each teacher / a imparts, you can ask additional tasks without having to be necessarily considered assessment tasks, but delivery obligations.

Delivery of work is primarily done via the virtual campus. They may enable other routes of delivery, in agreement with the teachers, informed via attendance in class and via virtual.o moodle campus. No work delivered by way not agreed with the teacher / a nor work with incorrect formats, which do not include the names of the authors and subject matter to which they refer or sent after the deadline will be accepted.

Since the lingua franca of the master and secondary education is Catalan, oral and written tasks related to this module will be presented in this language. In written tasks, linguistic correction, composition skills and formal

presentation aspect will be considered. Nevertheless, it is necessary to express yourself with fluency and correction in oral activities. A prominent level of comprehension of academic documents will also be required. An activity may not be assessed, not given back or failed if any of the mentioned requirements are not accomplished.

Work and examinations will be assessed at most one month after delivery or performance.

According to the regulations UAB, plagiarism or copying of any work will be penalized with a 0 rating, losing the ability to recover, whether it is an individual work and group (in this case, all group members will have a 0).

History of Science

To assess this course, students must write an essay from 1200 to 1500 words abous the didactic applications of the course contents. Specific indications will be given during the course lessons. Delivery date: 7/02/2020

Fundamentals of Biology

- Specific activities for implementing the contents worked, as can be the answer to some questions from the PAU exams: 35%. Delivery date: at the end of each class

- Interdisciplinary project linked to Fundamentals of Physics: 65%. Delivery date: 29/04/2010

Fundamentals of Geology

- Interpretation assignment of the field work: 35%. Delivery date: 13/12/2019

- Interdisciplinary project linked to Fundamentals of Physics: 65%. Delivery date: 7/02/2020

Fundamentals of Chemistry

- Lab book: 35%. Delivery date: at the end of each class

- Interdisciplinary project linked of Chemistry and Biology: 65%. Delivery date: 29/04/2020

Fundamentals of Physics

- Video activity: 35% Delivery date: 12/01/2020

- Interdisciplinary project linked of Chemistry and Biology: 65%. Delivery date: 7/02/2020

Topics of Current Science

- Attendance at meetings

Introduction to Science Education

- Personal reflection in relation to an ideal science class.50%. Delivery date: 24/10/2019

- Suggestion of a competency question for assessment purposes 50%. Delivery date: 24/10/2019

Physics Didactics

- Microteaching activity 50%. Delivery date: 13/03/2020

- Design of an individual and recoverable activity. 50%. Delivery date: 20/12/2019

Chemistry Didactics

- Microteaching activity 50%. Delivery date: 13/03/2020

- Design of an individual and recoverable activity. 50%. Delivery date: 13/03/2020

Teaching innovation and introduction to research in Phisics and Chemistry didactics

- Design of a proposal ABP 35%. Delivery date: 30/04/2020

-Portfolio personal 40%. (two entries in the whole course, digitally in a moodle forum, where the aspect of the course that has most interested in the preparation of your teaching unit will be discussed). First entry: 31/01/2020. Second entry: 15/04/2020

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Avaluació d'Innovació educativa i iniciació a la recerca	22,22%	0	0	15, 1, 13, 3, 4, 5, 7, 2, 6, 8, 18, 9, 11, 10, 12, 14, 16, 17, 19
Avaluació d'Introducció a la didàctica de les ciències	11,11%	0	0	15, 1, 6, 14
Avaluació d'història de les ciències	14,81%	0	0	15, 1, 4, 7, 14
Avaluació de complements de física, química, biologia i/o geologia	29,62%	0	0	15, 1, 3, 4, 5, 7, 6, 18, 14
Avaluació de didàctica de la física	11,11%	0	0	15, 1, 13, 3, 4, 5, 7, 2, 6, 8, 18, 9, 11, 10, 12, 14, 16, 17, 19
Avaluació de didàctica de la química	11,11%	0	0	15, 1, 13, 3, 4, 5, 7, 2, 6, 8, 18, 9, 11, 10, 12, 14, 16, 17, 19

Bibliography

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Terminologia: http://cit.iec.cat

Web de ciències en context: http://www.cienciesencontext.com/

Magazines

Enseñanza de las Ciències de la Tierra (AEPECT): http://www.aepect.org/larevista.htm

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Enseñanza de las Ciencias. Revista de Investigación y Experiencias Didácticas. http://www.raco.cat/index.php/ensenanza

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