Soil Science

Code: 106770
ECTS Credits: 6

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Degree	Type	Year
Environmental Sciences	OB	3

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Although there are no official prerequisites, it is advisable for the student to review:

1. The basic knowledge of Biology and Geology, or Earth and Environmental Sciences that they have acquired during compulsory secondary education and high school.
2. The basic science knowledge related to the contents of this subject that they have acquired in subjects within the fields of biology, ecology, geology, physics, and chemistry.

Objectives and Contextualisation

The general objective of this subject is to provide a cross-disciplinary and interdisciplinary education that allows the student to understand the environmental properties and functions of soils, the services they provide to society, their diversity and the suitability of different soil types for various uses, the main causes and environmental problems that lead to their degradation, and the appropriate and viable corrective or rehabilitation measures.

Specific objectives:

- Learn to describe, sample, analyze, and interpret a soil in relation to the natural factors that influence its formation.
- Identify the main components of soil and interpret their properties.
- Understand the bases of soil classification to interpret its diversity and environmental value.
- Assess the use capacity of soils based on their properties.
- Identify, understand, and evaluate the most common soil degradation problems (erosion, salinization, contamination, loss of organic matter, etc.) and apply this knowledge to formulate viable solutions to these.

- Recognize the main environmental functions of soils to know how to leverage them in solving current environmental problems.
- Critically select information from various sources about real soil degradation problems and apply knowledge in an integrated manner to propose viable prevention and conservation measures.
- Communicate the importance of soils and their conservation effectively and creatively using new communication and information technologies.
- Demonstrate initiative, versatility, and interest in both autonomous and team work.

Learning Outcomes

1. KM46 (Knowledge) Identify the most important chemical and geological processes in the different environmental compartments (hydrosphere, soil and atmosphere).
2. KM47 (Knowledge) Recognise the way in which human activity has an impact on the function of physical vectors (water, soil, oceans, atmosphere) in the natural environment.
3. KM48 (Knowledge) Compare the basic principles of science (hydrology, marine sciences, climatology, soil sciences, etc.) that constitute the basis for the study of the Earth system from an environmental perspective.
4. SM46 (Skill) Characterise the main processes of natural environments (marine, soil, atmosphere), including aspects of physics, chemistry, geology, biology and their interaction.

Content

CLASSES OF CONCEPTS, EXPERIENCES, AND CASE STUDIES

MODULE I: Soil as a Natural System

Topic 1: Soil Concept

- Importance of soil for humanity
- Functions of soil and ecosystem services
- The science that studies soil: Edaphology
- Soil as an interface of environmental compartments
- Soil as a natural resource
- Global stagnation of agricultural production increase
- Food security against climate change
- Soil degradation

Topic 2: Soil Formation and Morphological Description of Soil Profile

- How soil is formed: Forming factors and main edaphogenic processes
- Soil profile and pedon
- Genetic horizons and dominant edaphogenic processes
- Degree of soil development
- Naming of soil horizons
- Organic horizons (H and O)
- Organo-mineral horizons (A)
- Mineral horizons (E, B, and C)

MODULE II: Soil Components

Topic 3: Soil Mineral Constituents

- Main types of parent materials
- Physical and chemical alteration and determining factors

- Climatic alteration gradient
- Most abundant minerals in soil
- Crystalline silicates
- Phyllosilicates or main groups of clays and their properties
- Amorphous silicates
- Oxides, hydroxides, and oxyhydroxides: characteristics and significance in soil
- Carbonates
- Chlorates and sulfates
- Susceptibility to chemical alteration of primary minerals
- Main chemical alteration processes

Topic 4: Organic Matter and Biological Activity of Soil

- Composition of soil organic matter (SOM)
- Soil as a carbon (C) reservoir
- Expression and calculation of SOM and Cstocks in soil
- Transformation of SOM
- Mechanisms of SOM stabilization
- Concept of carbon organic saturation (COS)
- Geographic distribution of SOM
- Distribution of SOM in the soil profile
- Ecosystem functions of SOM
- Effects of climate change and global factors on SOM

MODULE III: Physical Properties of Soil

Topic 5: Organization of Soil Components

- Soil architecture
- Color: its importance and determination
- Soil temperature and temperature regime
- Texture: its importance and determination
- Soil structure: formation processes, types, and ecosystem functions
- Structure stability and causes of degradation: crusting and compaction
- Measures for increasing or recovering structural stability
- Porosity and functions of pore space
- Bulk density and apparent density: determination methods

Topic 6: Soil as a Water Reservoir

- Forces acting on soil water: water retention in soil
- Quantitative measurement of soil moisture
- Qualitative measurement of soil moisture: water potential, water states, and CRAD
- Water fractions in soil
- Moisture characteristic curve
- Types of water movement in soil
- Hydraulic conductivity or permeability: measurement of infiltration and percolation
- Factors determining permeability
- Drainage and indicators of drainage degree
- Water balance and soil moisture regime
- Water conservation in soil and irrigation and drainage techniques

MODULE IV: Soil Physicochemical Properties

Topic 7: Soil Physicochemical Properties

- Type of interactions in the solid-liquid interface
- Soil colloids, ion exchange, and diffuse double layer
- Cation exchange capacity (CEC): determination and importance
- Anion exchange capacity (AEC)

- Relationship between CEC/AEC, acidity, and soil alteration degree
- Degree of base saturation (DBS)
- Importance and significance of soil pH
- Sources and effects of soil acidity. Soil buffering capacity
- Measurement of actual and potential pH
- pH corrections in acidic and alkaline soils
- Salinity: causes, effects, and measurement
- Sodicity and alkalinity: causes, effects, and measurement
- Treatment of saline and sodic soils

MODULE V: Diversity, Mapping, and Soil Evaluation

Topic 8: Soil Classification

- Why do we need a soil classification system?
- Pedon as a classification unit
- Current classification systems
- Diagnostic elements
- Genetic horizons vs. diagnostic horizons
- Major diagnostic horizons
- The Soil Taxonomy system (USDA). Definition of major taxonomic groups
- Types of soils and their frequency in Catalonia

Topic 9: Soil Mapping and Evaluation

- Uses and applications of soil maps
- Classes of cartographic units
- Types of soil maps: objectives and scales
- Relationship between map scale and observation density
- Procedure for soil map creation
- Criteria for map quality
- Soil evaluation systems
- Classes of agrological capacity (USDA)
- FAO land evaluation

BLOCK VI: Soil Degradation Processes and Rehabilitation

Topic 10: Soil Degradation Processes

- Soil formation versus degradation
- Soil degradation in Catalonia and globally
- Main factors, causes, and types of soil degradation
- Assessment of soil quality and degradation status. Quality indicators
- Acceptable degradation rates and soil lifespan
- Costs of degradation and the link between soil degradation and poverty
- Sustainable soil use
- Existing organizations and policies for soil protection

PRACTICAL TRAINING

Field Practices: Field Study of Soils: Morphology, Description, and Sampling

- Description of the soil formation environment
- Opening of a soil pit
- Elements of profile description
- Observation and morphological description of horizons and their interpretation
- Sampling and preservation for analytical purposes

Laboratory Practices: Soil Analysis

- Preparation of samples for analysis
- Determination of stoniness
- Determination of soil color in dry and wet conditions
- Determination of moisture content
- Determination of particle size distribution and texture
- Determination of real and potential pH
- Determination of carbonate content
- Determination of salinity
- Determination of oxidizable organic carbon and organic matter
- Integrated interpretation of analytical results from different soil types

Classroom Practices: Interpretation of Soil Analyses

- Interpretation of soil analyses
- Diagnosis of soil degradation problems through case studies
- Independent exercises interpreting soil analyses and profiles

Collaborative Autonomous Work and Tutoring: Identification of Soil Degradation Problems and Proposal of Corrective Measures

- Identification of a real case of soil degradation or the degradation problems affecting an area
- Selection and compilation of information about the study area (physical and biotic environment, soil types) and its socio-economiccontext
- Interpretation of the territory regarding soil types, their uses, and thestate of conservation or degradation
- Analysis of the degradation problem(s) and explanation of their causes and soil processes
- Evaluation of the magnitude and importance of the degradation problem, its implications, and consequences
- Assessment of potential economic, environmental, and social conflicts caused by the degradation problem(s)
- Evaluation and proposal of viable preventive and conservation measures or practices
- Conclusion and synthesis of the main soil degradation problem in the area, its main causes and consequences, and the most feasible measures that could be implemented as a priority to prevent or address this problem.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Classes of concepts, experiences and cases of study	30	1.2	KM46, KM47, KM48, SM46, KM46
Field practices	6	0.24	KM46, KM47, KM48, SM46, KM46
Laboratory practices	12	0.48	KM46, KM47, KM48, SM46, KM46
Type: Supervised			
Case study and problems	2	0.08	KM46, KM47, KM48, SM46, KM46
Field work	3	0.12	KM46, KM47, KM48, SM46, KM46
Type: Autonomous			
Autonomous and collaborative work (video)	25	1	KM46, KM47, KM48, SM46, KM46

Case study and problems	10	0.4	KM46, KM47, KM48, SM46, KM46
Personal study	56	2.24	KM46, KM47, KM48, SM46, KM46

Various teaching-learning strategies will be combined so that students achieve the objectives of the subject.

1. Classes of concepts, experiences, and cases of study. The expository sessions constitute the main activity since they allow the basic concepts to be transmitted to the students in a short time. The lectures will be accompanied by notes and other teaching materials that, if necessary, will be made available to the students through the virtual campus. Learning the concepts and content explained in the classes requires the student's personal study to assimilate them. As a guideline, it is estimated that each hour of concept class requires two hours of personal study.

2. Field practices. These are essential for the student to get to know soil in nature and learn to make a representative description and sampling. They will consist of a mandatory full-day outing in which the teachers will explain in detail how to study soil in the field, and then the students, in small groups, will describe the environment where it was formed, dig a pit, describe the different horizons that form it, and take samples for analytical purposes. (5 hours directed + 3 hours supervised work). If, due to force majeure, the field trip cannot be carried out, it will be replaced by alternative activities.

3. Laboratory practices. These sessions are designed for students to learn the most common international analytical procedures for soil characterization, but also to obtain sufficiently reliable and representative results from the field samples. They will be organized into three four-hour sessions in which the students, maintaining the same groups as in the field, will analyze the collected samples. A brief report will be submitted containing the soil description, analytical results, and their interpretation. (12 hours directed). If, due to force majeure, laboratory practices cannot be carried out, they will be replaced by exercises and/or case studies.

4. Autonomous and collaborative work. This consists of the creation of a video-documentary about a soil degradation process or about soil degradation processes affecting a specific area. The video will include an explanation of the soil degradation processes and mechanisms involved, their relevance and implications, as well as corrective measures that could be carried out and their potential viability. The video may include interviews, field visits, or visits to centers (e.g., waste treatment, sewage treatment plants, etc.). As a preliminary evaluable activity, a script with the contents of the video, the target audience, and communication objectives (e.g., educational and training, dissemination, informational, awareness, etc.) will be submitted. The maximum duration of the video will be 10 minutes. The video will be made in groups of 3-5 people. A preparation session will be held to explain the task (1 hour). Evaluable activity (25 hours of group work). Voluntary tutorials will be held in which the teachers will guide the progress of the work and a collective session will be held to present some of the final works.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Brief practice report	10%	1	0.04	KM46, KM47, KM48, SM46
Final exam	35%	2	0.08	KM46, KM47, KM48, SM46
First midterm exam	30%	2	0.08	KM46, KM47, KM48, SM46

Video documentary on soil degradation processes	25%	1	0.04	KM46, KM47, KM48, SM46

This subject does not contemplate unic evaluation.

The assessment of this subject is continuous throughout the course and has a formative nature. It is based on the following elements:

1. First midterm exam. It consists of short-answer questions and/or exercises on the main concepts of the subject taught up to the time of the exam.

2. Final exam. It consists of short questions and/or exercises related to the knowledge explained in the entire subject, especially those corresponding to the thematic block of degradation processes and their correction.

3. Brief practice report. It consists of the presentation, for each practice group, of the description of the soil profile carried out during the field practices, the interpretation of those factors involved in the formation of the soil, and the results of the laboratory analyzes of each practice group, with a justification or interpretation of these. Correct interpretation and critical evaluations will be valued. This activity is not recoverable.

4. Video documentary on soil degradation processes. A first evaluation consists of the presentation of a script for the video, made in a group, on a process or processes of degradation of an area, the mechanisms involved, their relevance and implications, as well as the corrective measures that could be carried out and their potential viability. A first submission of a video script will be made, worth 33% of the final video grade, one month before the final presentation. After this submission, students will receive feedback from the responsible professor and must make the pertinent modifications. The final video will have 66% of the grade weight. The projection of some of the videos will be done in a joint session at the end of the course. This activity is not recoverable.

To pass this subject, the student must obtain an overall score higher than 4.9. Students who do not achieve this score and have been evaluated in at least 2/3 of the total grade of the subject can take a globalrecovery test of the midterm and final exams, as long as they have obtained a minimum average grade of 3.5 in the subject, according to the current regulations of the UAB. Not submitting a test or assignment will result in a score of zero. Teachers will schedule and communicate through the virtual campus the day, time, and place for the review of the provisional grades awarded to each evaluable activity. Reviews outside this schedule will not be accepted.

Students receive the grade of "Not Evaluable" when the evaluation activities carried out have a weighting of less than 67% in the final grade or when their absence is greater than 20% of the scheduled mandatory sessions. Attendance at practical sessions or field trips is mandatory.

Bibliography

Accessible web links and documentation will be provided online trhough the Virtual Campus.

Basic bibliography:

- Brady N. C. & R. R. Weil. 2017. The nature and properties of soils (15th ed.). Prentice Hall Upper Saddle River, New Jersey. 975 p.
https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991007729899706709

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https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991008541239706709

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- Porta, J., M. López-Acevedo & R. M. Poch. 2014. Edafología: uso y protección de suelos, 3ª ed, Mundi-Prensa. https://bibcercador.uab.cat/permalink/34CSUC_UAB/avjcib/alma991010859405906709

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- Tan, K. H. 2009. Environmental soil science. Marcel Dekker. New York. https://bibcercador.uab.cat/permalink/34CSUC_UAB/avjcib/alma991001885739706709

- TRAGSA (1998). Restauración hidrológico forestal de cuencas y control de la erosión. Ed. Mundi Prensa. https://bibcercador.uab.cat/permalink/34CSUC_UAB/1eqfv2p/alma991007376959706709

- USDA - NRCS. 2006. Claves para la Taxonomïa de Suelos. Keys to Soil Taxonomy | NRCS Soils (usda.gov)

Web links:

-USDA - Natural Resources Conservation Service: https://www.nrcs.usda.gov/wps/portal/nrcs/site/soils/home/

- FAO Soils Portal: http://www.fao.org/soils-portal/en/

- Universidad de Granada. Departamento de Edafologïa y Quïmica Agrïcola: http://edafologia.ugr.es/index.htm

- Institut d'Estudis Catalans. Protecció de sòls, mapa de sòls de Catalunya: http://www.iec.cat/mapasols/

- Institut Cartogràfic i Geològic de Catalunya: https://www.icgc.cat/

- Sociedad Española de Ciencias del suelo: https://www.secs.com.es

- The nature Education Knowledge Project, Soil, Agriculture and Agricultural Biotechnology: https://www.nature.com/scitable/knowledge/soil-agriculture-and-agricultural-biotechnology-84826767/

- Soil-net. Welcome to Soil-net.com. http://www.soil-net.com/

- International Union of Soil Sciences. Soil science education. http://www.iuss.org/popup/education.htm

- European Society for Soil Conservation http://www.soilconservation.eu/

Software

Commonly used Microsoft Office programs will be used. Also, commonly used GIS software.

Various internet resource search engines.

Free video editing programs (iMovie, Biteable, Shotcut, OpenShot, VideoPad, Lightworks, WeVideo, etc.)

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PCAM) Field practices	1	Spanish	first semester	morning-mixed
(PCAM) Field practices	2	Spanish	first semester	morning-mixed
(PLAB) Practical laboratories	1	Spanish	first semester	afternoon
(PLAB) Practical laboratories	2	Spanish	first semester	afternoon
(PLAB) Practical laboratories	3	Catalan	first semester	afternoon
(PLAB) Practical laboratories	4	Catalan	first semester	afternoon
(TE) Theory	1	Spanish	first semester	morning-mixed