Universidad de Navarra

Geology (F. Ciencias)

Teaching guide 2026-27

INTRODUCTION

Course Description:

This course provides students with a comprehensive insight into the physical environment by studying Earth within a planetary and cosmic context. It explores key topics such as the planet's origin, internal structure, composition, and properties to elucidate geological processes from its formation to the present day. This foundation is built upon core disciplines including stratigraphy, paleontology, and internal geodynamics.

Furthermore, through the study of geomorphology, students will understand how landforms evolve on the Earth's surface as a result of climate interactions and internal geodynamic processes.

- **Degree: Biology/Environmental Sciences**
- **Module in the Degree Program**: **Module IV: Ecosystems / Module I: Scientific Bases of the Environment.**
- **Subject in the Degree Program: Physical environment and vegetation / Earth Sciences**
- **Number of credits: 6 ECTS**
- **Year:** First, 1st semester
- **Type of course:** Mandatory
- **Instructors**: Delia Rodríguez Oroz, Esther Lasheras Adot
- **Language:** English
- **Department:** Chemistry, School of Science.
- **Lecture schedule, 2026-2027 academic year**
  - Lectures in ROOM 17: Tuesday 10:00-11:00 and Thursday & Friday 11: 00-12:00.
  - Practical sessions:
    - **General geology** Lab 5D10 (5th-floor Sciences Building)**:** 5 sessions (1,5 hours each) and 1 session 30 min, starting the 2nd week of the term; in groups that will be established before the start of the course.
    - **Geomorphology**: 4 single-group sessions: Thursdays, November 5, 12, 19 & 26 in ROOM 21 (From 12:00 to 14: 00)

LEARNING OUTCOMES (Competencies)

- **Degree in Biology:**
- Upon completing this course, students will acquire the core competencies—encompassing knowledge, practical skills, and learning outcomes—established in the Official Bachelor of Science in Biology at the University of Navarra. These competencies are formally integrated into Module IV: Ecosystems.
- Learning Outcomes:
  - RA5 Describe the physical environment (soil, water, atmosphere, and climate), the landscape, mapping tools, remote sensing, and models to evaluate global change and its effects.
  - RA11 Perform analysis in health, industrial, agri-food, and environmental fields to solve problems through the scientific method.
  - RA13 Communicate effectively, both orally and in writing, scientific-technical aspects that allow for correct didactics and dissemination of Biology.
  - RA18 Critically assess scientific information from different sources, issuing reasoned judgments based on verified evidence.

  - RA19 Identify current or future scientific challenges related to biology, biomedicine, and the environment, communicating their relevance for development and social innovation.
  - RA23 Collaborate actively and inclusively in academic environments, respecting diversity and contributing to constructive coexistence.
  - RA24 Value the natural environment and life as common goods that must be conserved for future generations.
- **Degree in Environmental Sciences**
- Upon completing this course, students will acquire the core competencies—encompassing knowledge, practical skills, and learning outcomes—established in the Official Bachelor of Science in Environmental Sciences at the University of Navarra. These competencies are formally integrated into Module I: Scientific Bases of the Environment.
- Learning Outcomes:
  - RA1 Identify the scientific bases necessary to describe the structure, physicochemical properties, and reactivity of the elements and compounds involved in biogeochemical processes.
  - RA2 Classify the physical environment, including its geological aspects and soils, both their characteristics and their typology.
  - RA9 Use geographic information systems to interpret spatial data and develop thematic environmental mapping, integrating remote sensing images.
  - RA11 Critically evaluate the factors involved in natural and technological risks.
  - RA29 Communicate in writing and orally on environmental issues, adapting the style and language to the situation and the interlocutor.
  - RA30 Apply ethical and sustainability principles in decision-making related to the management, conservation, and protection of the environment and ecosystems.
  - RA32 Interpret relevant data to issue judgments that include reflection on important social, scientific, or ethical issues.RA33 Critically analyze the relationship between humanity and nature in the context of socio-environmental dilemmas, integrating ethical, ecological, and social perspectives beyond economic interest.

PROGRAM

PART I: PRELIMINARY COURSE (Lessosn 1 to 4)

1. FUNDAMENTALS OF GEOLOGY: Geology, definition. Geology in history. Study methods. Relation with other sciences. Fundamental principles of Geology. Geological events. EARTH IN THE UNIVERSE: The universe. Origin and evolution.

2. SOLAR SYSTEM: Formation and distribution of matter in the solar system. Solar System. Planetary bodies.

3. EARTH STRUCTURE: Primary geochemical differentiation. Atmosphere, Hydrosphere, Biosphere, and Geosphere: structure, layers, and discontinuities. Composition and characteristics of Earth's Core, Mantle, and Crust. Asthenosphere and lithosphere.

4. EARTH ENERGY: Energy fluxes. Magnetism. Thermal and mechanical energy: volcanism and seismicity. Gravity and isostasy.

PART II: GENERAL GEOLOGY (Lessons 5 to 8)

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5. EARTH COMPOSITION I: Crystallography and mineralogy. Crystalline material. Definition. Crystal lattice. Primitive cell. Crystal chemistry. Chemical bonding and coordination. Close packing. Common structures. Silicates. General properties. Crystal classes. Physical properties of geological material.

6. EARTH COMPOSITION II: Petrology: rock cycle. Endogenous and exogenous rocks. Chemical, physical and biological weathering. Erosion, transport, and sedimentation. Main agents and processes. Sediments. Sedimentary differentiation. Diagenesis. Exogenous rocks: detrital sedimentary rocks and chemical sedimentary rocks. Endogenous rocks: igneous and metamorphic rocks. Different environments for rock formation.

7. INTERNAL PROCESSES: Deformation of rocks. Factors and types. The geometry of deformations. Classification of tectonic processes. Faults and Joints: origin and types. Structural folds: origin and classification. Diapirs. Thrust nappe: origin and names. Tectonic types. Plate tectonics. Convergent, divergent, and transform plate boundaries. Oceanic ridges and subduction zones. Oceanic trenches and mountain ranges. Island arcs. Seismicity and volcanism.

8. HISTORICAL GEOLOGY: Paleontology and stratigraphy. Fossilization. Methods of study of fossils. Stratigraphic value. Fossil identification and classification. Paleontological associations. Principles of stratigraphy. Stratigraphic units. Facies: definition and types. Marine and continental facies. Principle of lateral continuity. Discontinuities. Stratigraphic correlation. Historical geology. Age of the Earth: methods of estimation. Geochronological units. Biozone. Stages. Systems, Periods, and Eras. Main geological features of the Iberian Peninsula and Navarra.

PART III: GEOMORPHOLOGY (Lessons 9 to 12)

9. GEOMORPHOLOGY I : Analysis of landforms. Morphogenetic systems. Forms related to climate:

- Morphology of temperate areas: Water action. River flow and gauging. Erosion, transport, and sedimentation. Torrential action. River balance. Meanders. River basins and watersheds. Types of watersheds: lithological and structural interpretation. Accumulation forms: fluvial terraces.
- Morphology of (hot-arid) inter-tropical areas: Wind action. Deflation, abrasion, attrition. Glacis and inselbergs. Pediments, loess, regs. Endorheic and exorheic basins. Desertification.
- Morphology of cold areas: frost weathering and changes of temperature. Glaciers. Glacial erosion, transport, and sedimentation: characteristic features. Periglacial areas: characteristic features, permafrost. Recent glacial periods.
- Morphology of tropical zones. Weathering residues and morphology of tropical areas.

10. GEOMORPHOLOGY II: Forms related to lithology

- Landforms driven by sedimentary rocks: Karstic landscape and clayey rocks forms.
- Landforms driven by Igneous rocks: Plutonic (Granite) landscapes and Volcanic landscapes.

11. GEOMORPHOLOGY III: Forms related to structure:

- Structural morphology. Plateaus, tables, mesas and buttes. Canyons and gorges.
- Landforms associated with folded strata: isoclinal relief: cuestas, hogbacks, and homoclinal relief. Relief in vertical

strata; Relief in folded regions: Jurassic and inverted relief. Chevrons, plunging folds, periclinal closure. Morphology of fold belts.
- Morphology of faults.

12. GEOMORPHOLOGY IV: Related to ocean floor morphology and coastal landscape

- Coastal morphology. Wave action. Coastal erosion. Beaches. Longshore drift and tidal currents. Types of coasts. Estuaries, barrier islands, deltas, reefs. Marine terraces.
- Morphology of ocean basins. Continental margin. Continental shelf. Continental slope and submarine canyons. Seabeds. Abyssal plain, submarine mountains, and guyots. Mid-ocean ridges, rifts and transform faults. Oceanic trenches and island arcs.

PRACTICAL PROGRAM

LAB SESSIONS (in groups)

Session I: Basic mapping

Session II: Geological cross-section and terrain interpretation

Session III: Mineralogy: main identifying characteristics of minerals

Session IV: Petrology I: sedimentary and metamorphic rocks

Session V: Petrology II: igneous (plutonic & volcanic) and metamorphic rocks

Session VI: Final rock identification and characterization

ROOM SESSIONS (One group)

Session VII: Landform interpretation I

Session VIII: Landform interpretation II

Session IX: Landform interpretation III

Session X: Landform interpretation IV

EDUCATIONAL ACTIVITIES

I. CLASSROOM TEACHING ACTIVITIES (60 hours)

1. LECTURES. 34 hours

Methodology: lectures in the classroom, participative and interactive, where the fundamental concepts of the subject will be exposed.

Competences: Students will obtain the geological fundamentals according to those indicated in the general and specific competences.

2. PRACTICAL SESSIONS. 16 hours

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Methodology: practical classes in the lab where students will interact with different geological materials. Students must read and comprehend the practice guide in advance. Any absence from a practical session must be justified as soon as possible and made up during the same week in one of the scheduled groups.

Competences: Students will gain experience in the interpretation of landscape features through the use and manipulation of maps. Moreover, students will be able to differentiate the main types of rocks and minerals.

3. FIELD TRIP. 8 hours

Degree in Biology: Attendance is optional. Those students who commit to attending field trips will be assessed as environmental science students.

Degree in Environmental Sciences: Attendance is mandatory.

Methodology: Two field trips will be held where different aspects related to the knowledge gained throughout the course will be directly observed.

Competences: Students will develop capacities to interpret the geological context (lithological and structural) of the physical environment through direct observation. Identification of geological features.

4. GOOGLE EARTH PRESENTATION. 1 hour

Students will give an individual talk (5 minutes) in which they explain the geological and geomorphological features of a specific area using Google Earth. The presentation will be performed at the end of the semester and will be used to revise the course contents.

5. MIDDLE TERM EXAM. 1 hour

II. PERSONAL WORK (90 hours)

1. PERSONAL STUDY. 67 hours

Methodology: the student should study the material given in the theoretical classes, as well as the additional material proposed. For the environmental sciences students, part of the personal study is carried out in the field during the E&LP field trips.

Competences: Acquisition of the basic concepts of geology for the interpretation of the physical environment.

2. GUIDED AUDIOVISUAL PROGRESS (ADI) Topics 1 & 2. 3 hours

Methodology: The student will follow ADI material to study the first two topics of the first course. During this section, the student will complete several online activities.

Competences: The student will acquire the ability to carry out online courses and complete online tests to learn the most basic concepts of geology.

3. GOOGLE EARTH PROJECT 5 hours

Methodology: Students will use Google Earth to present the geological and geomorphological information of a place of geological interest.

Competences: Students will acquire the ability to visualize and interpret geological structures.

4. READING AND COMPREHENSION OF THE PRACTICE GUIDE. 7.5 hours

Methodology: Students will read the practice guide before attending classes. A practice guide will be given at the beginning of the course.

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Competences: Students will acquire the ability to comprehend and summarize the contents developed in the practical session.

5. ONLINE SELF-EVALUATING TESTS. 7.5 Hours

Methodology: Students will complete a series of self-evaluating tests for each topic to assess their progress.

Competences: Students acquire the habit of analyzing and relating the knowledge acquired throughout the course, topic by topic.

ASSESSMENT

ORDINARY CALL

In order to establish the final assessment, the marks obtained in the different parts of the course will be added together. Please note that the marks of the practical sessions, field trips, and Google Earth Project will **ONLY BE ADDED IF ALL THE THEORETICAL PARTS HAVE BEEN PASSED.** The final assessment, **which must be higher than 5 to pass the course** will be distributed as follows:

IN BIOLOGY

- Theoretical part 70%
  - Preliminary course 20%
  - General Geology 25%
  - Geomorphology 25 %
- Practical part 20 %
- Google Earth project 10%

IN ENVIRONMENTAL SCIENCES

- Theoretical part 60%
  - Preliminary course 20%
  - General Geology 20%
  - Geomorphology 20 %
- Practical part 20 %
- Field trips 10 %
- Google Earth project 10%

In detail, the evaluation of each part will be as follows.

THEORETICAL PART: The theoretical part will be graded with a final exam divided into 3 independent parts:

1. PRELIMINARY COURSE (it will take place in october): **Biology** & **Environmental Sciences** up to 2 points

The exam of this part will include 10 multiple-choice questions and 5 short questions. A minimum score of 1 will be required to pass this part of the subject.

2. GENERAL GEOLOGY: Biology up to 2,5 points/ **Environmental Sciences** up to 2 points

The exam of this part will include 10 multiple-choice questions (1,25 / 1 point) and 5 short questions (1,25 / 1 point). A minimum score of 1,25 points (**Biology**) or 1 point (**Environmental Sciences**)will be required to pass this part of the subject.

3. GEOMORPHOLOGY: **Biology** up to 2,5 points/ **Environmental Sciences** up to 2 points

The exam will consist of 24 questions where the student must interpret the geomorphology of 24 different locations. A minimum score of 1,25 points (**Biology**) or 1 point (**Environmental Sciences**) will be required to pass this part of the subject.

PRACTICAL PART: The remaining 20% of the final grade will be obtained from the individual follow-up of the student's performance in the practical classes. **This mark will only be added if all the theoretical parts are passed.**

FIELD TRIPS: The Field trip will be evaluated through questions in the field about what was observed on each trip. The maximum mark will be 1 (0,5 in each). **This mark will only be added if all the theoretical parts are passed.**

GOOGLE EARTH PROJECT: Google Earth presentation (see section before) will be assessed from 0 to 1. Assessment criteria will be based both on the originality of the chosen area and on the correct explanation of ALL identifiable geological features. **This mark will only be added if all the theoretical parts are passed**.

EXTRAORDINARY CALL

The student will take a final exam similar to that carried out in the examination period. Those students who have passed the midterm examination will not have to repeat this part and their marks will be taken into account when it comes to estimating their final grade. As for the practical part, the mark obtained during the examination period will be the one used in the final assessment.

STUDENTS WITH SPECIAL EDUCATIONAL NEEDS

For students with special educational needs, exceptions will be allowed regarding the methodology and/or assessment of the subject. Possible alternatives will be studied as long as they guarantee the effective acquisition of all the required skills.

OFFICE HOURS

- Delia Rodríguez Oroz
- Esther Lasheras Adot
  - Research Building. 1st floor, office 1090
  - Schedule an appointment

BIBLIOGRAPHY AND RESOURCES

Recommended literature

BASIC LITERATURE

- Tarbuck y Lutgens. "Earth. An introduction to physical geology". (2020). Pearson Education, 13th ed. Hoboken. Find it in the Library
- Tarbuck y Lutgens. "Ciencias de la Tierra. Una introducción a la Geología Física". (2005). Ed. Pearson-Prentice Hall, 8ª ed. Madrid. Find it in the Library
- Azañón, J.M. et al. "Geología Física". (2002). Ed. Paraninfo. Madrid. Find it in the Library
- Anguita, F.; Moreno, F. "Procesos geológicos internos". (1991). Ed. Rueda. Madrid. Find it in the Library
- Gutiérrez Elorza, M. "Geomorfología" (2008). Ed. Pearson-Prentice Hall. Find it in the Library

ADDITIONAL LITERATURE

- Anguita, F. "Origen e historia de la Tierra". (1988). Ed. Omega. Barcelona. Find it in the Library

- Bayly, B. "Introducción a la petrología". (1982). Ed. Paraninfo, 2ª ed. Madrid. Find it in the Library
- Corrales, I. Rosell, J.; Sanchez de la Torre, L.; Vera, J.; Vilas, L. "Estratigrafía". (1977). Ed. Rueda. Madrid. Find it in the Library
- Klein, C.; Hurlbut Jr., C.S. "Manual de Mineralogía" 4ª ed. * Basado en la obra de J. Dana. (1998). Ed. Reverté. Barcelona. Find it in the Library
- Klein, C.; Philpotts, A. "Earth Materials". (2015). Cambridge University Press. Find it in the Library
- Pozo Rodríguez, M. et al. "Geología Práctica. Introducción al reconocimiento de materiales y análisis de mapas". (2004). Ed. Pearson Educación. Madrid. Find it in the Library
- Strahler, A. N. & Strahler. A.H. "Geografía física". 3ª Ed. 1994 Editorial Omega. Find it in the Library
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