Universidad de Navarra

*Geology (F. Ciencias)*

*Teaching guide 2023-24*

# INTRODUCTION

**Course Description:**

This subject aims to help the student gain insight into the fundamental aspects related to the physical environment, by studying the Earth as a planet in the Universe. Essential aspects such as its origin, internal structure, composition, and properties will be studied in order to fully understand the processes that have taken place from its formation to now, through geological disciplines such as stratigraphy, paleontology, and internal geodynamics.

Likewise, through the knowledge of Earth's Geomorphology, the student will gain a better understanding of the different types of landforms, the result of the interaction with the climate, and the processes of internal geodynamics manifested in the terrestrial surface.

- **Degree: Biology/Environmental Sciences**
- **Module in the Degree Program**: **Module V: Population and ecosystem organization / Module I: Scientific Basis of the Environment.**
- **Number of credits: 6 ECTS**
- **Year:** First, 2º semester
- **Type of course:** Mandatory
- **Instructors**: Delia Rodríguez Oroz, Esther Lasheras Adot
- **Language:** English
- **Department:** Chemistry, School of Science.
- **Lecture schedule:**
  - ROOM 17. Monday (9:00-10:00), Tuesday (10:00-11:00), and Friday (12:00-13:00)
  - Practical sessions: **General geology** Lab 5D08 (5th-floor Sciences Building)**:** 6 sessions (2 hours each) starting the 2nd week of the term; in groups that will be established before the start of the course (see Google calendar). **Geomorphology**: 4 Sessions (2 hours each) in an only group (see Google calendar)

# COMPETENCIES

- **Degree in Biology:**
  - CE14 Knowing the nature of the physical environment and understanding the interactions among organisms and their environment, or among them at the different levels of ecological hierarchy: organism, population, community/ecosystem
  - CB1 Students have demonstrated to possess and understand basic knowledge in an area of study, acquired in secondary education, and have reached a level that allows them not only to rely on advanced textbooks but also to incorporate knowledge at the forefront of their field of study.

- CG2 Holistic thinking, being able to tackle problems from different approaches. Development of critical thinking. Providing solutions to scientific problems
- CG3 Working in a team. Selecting and choosing the correct work methodology, and establishing an appropriate distribution of functions. Know how to listen and speak with positive and constructive interventions.
- CG4 Developing a sense of responsibility towards Life, the Environment, and the Ecosystems with an ethical sense. Finding and evaluating information and being able to analyze, synthesize, summarize, communicate, mention, and make presentations of works.

- Degree in Environmental Sciences
  - CE6 Describe the physical environment, including geological aspects
  - CG2 Holistic thinking, being able to tackle problems from different approaches
  - CG3 Development of critical thinking
  - CG4 Working in a team
  - CB1 Students have demonstrated to possess and understand basic knowledge in an area of study, acquired in secondary education, and have reached a level that allows them not only to rely on advanced textbooks but also to incorporate knowledge at the forefront of their field of study.
  - CB2 Students must know how to apply knowledge to their work or vocation in a professional way and have the appropriate capabilities that are usually demonstrated through the elaboration and defense of arguments and the problem-solving within their area of study

## PROGRAM

GEOLOGY : PART I: PRELIMINARY COURSE (Lessons 1 to 4) & PART II: GENERAL GEOLOGY (Lessons 5 to 8)

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

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 basin. Desertification.

Morphology of cold areas: frost weathering and changes of temperature. Glaciers. Glacial erosion, transport, and sedimentation: characteristics features. Periglacial areas: characteristics features, permafrost. Recent glacial periods.

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.

GEOMORPHOLOGY III: Forms related to structure:

Structural morphology. Plateaus, tables, mesas and buttes. Canyons and gorges.

Isoclinal landforms. Landforms with vertical strata.

Landforms driven by faults and folds. Inverted relief. Morphology of fold.

GEOMORPHOLOGY IV: Related to ocean floor morphology and coastal landscape

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.

Coastal morphology. Wave action. Coastal erosion. Beaches. Longshore drift and tidal currents. Types of coasts. Estuaries, barrier islands, deltas, reefs. Marine terraces.

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: Rocks in the Campus

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

Classroom teaching activities

Degree in Biology (75 hours, 3 ECTS)

Degree in Environmental Sciences (81 hours, 3,24 ECTS)

1. LECTURES. 40 hours (1.6 ECTS)

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

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

2. PRACTICAL SESSIONS. 20 hours (0.8 ECTS)

Methodology: practical classes in the lab where students will interact with different geological materials. Students must read and comprehend the practice guide in advance. Practical classes are of compulsory attendance.

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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. 12 hours (0.48 ECTS)

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

Degree in Environmental Sciences: Attendance is mandatory.

Methodology: There will be held two field trips 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. 3 hours (0.12 ECTS)

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

5. EXAMS. 5 hours (0.2 ECTS)

6. TUTORING. 1 hour (0.04 ECTS)

Personal work

Degree in Biology (75 hours, 3 ECTS)

Degree in Environmental Sciences (69 hours, 2, ECTS)

1. READING AND COMPREHENSION OF THE PRACTICE GUIDE. 7.5 hours (0.3 ECTS)

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

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

2. GOOGLE EARTH. 10 hours (0.4 ECTS)

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.

3. BIBLIOGRAPHIC RESEARCH AND ADDITIONAL READING. 7.5 hours (0.3 ECTS)

Methodology: at the suggestion of the professor, students will carry out bibliographic research to complement several topics.

Competences: Students will acquire expertise in the searching, reading, and comprehension of specific subjects.

4. PERSONAL STUDY.

**Degree in Biology (50 hours, 2 ECTS)**

**Degree in Environmental Sciences (44 hours, 1,76 ECTS)**

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.

- 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 will be distributed as follows:

IN BIOLOGY

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

IN ENVIRONMENTAL SCIENCES

- Theoretical part 60%
  - Preliminary course 20%
  - General Geology 20%
  - Geomorphology 20 %
- Practical part 20 %
- Field trips 10 %
- Google Earth project (optional) 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 throughout the month of February): **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. **It is recalled that practical classes are MANDATORY**. **This mark will only be added if all the theoretical parts are passed.**

IMPORTANT: STUDENTS WHO HAVE NOT COMPLETED ALL THE PRACTICAL SESSIONS WILL NOT BE ALLOWED TO TAKE THE THEORY EXAMS.

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.

# OFFICE HOURS

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

# BIBLIOGRAPHY AND RESOURCES

## Recommended literature

BASIC LITERATURE

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- Tarbuck y Lutgens. "Earth. An introduction to physical geology". (1996). Ed. Prentice Hall, 5th ed. Madrid. Find it in the Library; (Ed. 2020) 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; (Ed. 2013) Find it in the Library [electronic resource]
- 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
- Biblioteca | Catálogo | Biblioguías