Funded by the European Union

TEACHER IMPLEMENTATION GUIDE

#EMME CURRICULUM

MEMORY OF THE EARTH

AUXILIARY

TABLE OF CONTENT

ABOUT
THIS GUIDE

The Teacher Implementation Guide has been created to support schools, teachers, and educational communities in integrating the #EMME – „*Memory of the Earth*” curriculum and the accompanying mobile app into authentic learning experiences.
It consolidates the project methodology, didactic principles, digital tools, and practical classroom strategies.

The guide also responds to the recommendation received during the mid-term evaluation by clearly defining how, where, and at what curricular level the EMME Curriculum can be implemented.

WHAT

TYPE OF CURRICULUM IS #EMME?

01. A Curriculum at school decision

Recommended for formal implementation as:

- an optional subject (1 hour/week)
- a thematic module within existing subjects (Geography, Biology, History, Sciences, Civic Education)
- a semester course led by a multidisciplinary team of teachers

02. A Local Development Curriculum

Can be implemented as:

- a locally developed module linked to environmental education
- a curricular “*mini-program*” aligned with GreenComp and Key Competences
- a cross-curricular project involving multiple classes or year groups

03. An Open Educational Resource

Schools may also integrate EMME informally through:

- project weeks
- science clubs
- Geopark collaborations
- outdoor learning programs
- thematic school events

Recommended educational level:

Lower secondary and upper secondary students (ages 11–18).
Each module contains both introductory and advanced learning pathways.

IMPLEMENTATION

PRINCIPLES

01. **Interdisciplinarity**

Combining geosciences, ecology, culture, and digital mapping.

02. **Place-based learning**

Using local landscapes, raw materials, heritage, and geology as learning resources.

03. **Experiential learning**

Outdoor activities, fieldwork, inquiry-based science, creative reflection.

04. **Digital integration**

Using the EMME mobile app, AR/VR tools, digital mapping, and online collaboration.

STEPS FOR IMPLEMENTATION

01. School decision & approval

Schools decide the implementation level.
A short approval package should include:

- curriculum summary & rationale
- timetable proposal
- list of teachers involved
- modules selected for the year
- alignment with Key Competences & GreenComp

02. Teacher team formation

A multidisciplinary team is recommended:

- Geography / Geology
- Biology / Environmental Science
- History / Culture
- ICT / Digital skills
- Language teachers (reporting, storytelling)

03. Planning the School Year

Suggested structure:

- 1 year → all 5 modules
- Semester → 2–3 modules
- Project week → a single module intensively

Each module includes:

- 1 theoretical lesson
- 1 applied task
- 1 local case study
- 1 creative or fieldwork activity

04. Collaboration with Local Geoparks

Schools located near geoparks should:

- contact the Education Department of the Geopark
- schedule 1–2 field visits
- use Geopark educational centers
- consult experts for local case studies

05. Digital Integration with the EMME App

Teachers should:

- use the Teacher Toolkit for the app
- test the AR features before class
- integrate quizzes, virtual tours, and interactive stories
- collect evidence for learning portfolios

06. Assessment & Feedback

Assessment options include:

- student portfolios
- group presentations
- field journals
- creative mapping exercises
- reflection tasks ("Memory of the Earth" logbook)

Teacher feedback should be shared with partners to improve the curriculum.

LESSON PLAN

EARTH'S BUILDING MATERIALS

Title of the lesson:

Earth's Building Materials: Rocks, Minerals and the Rock Cycle

Curriculum Unit:

Unit 1 — Geology and Paleontology
Lesson 1.1 — Earth's Building Materials

Duration:

1 learning session (50 minutes)

Learning objectives:

By the end of this lesson, students will be able to:

- Identify what minerals are and how they form rocks.
- Distinguish between igneous, sedimentary, and metamorphic rocks.
- Describe the rock cycle in simple steps.
- Classify rock samples based on visible characteristics.
- Explain why rocks are important for understanding Earth's history.

Key concepts:

- Minerals = *building blocks of rocks*
- Three types of rocks: igneous, sedimentary, metamorphic
- How each rock type forms
- Basic rock cycle
- Rocks as memory archives of Earth's past

Materials needed:

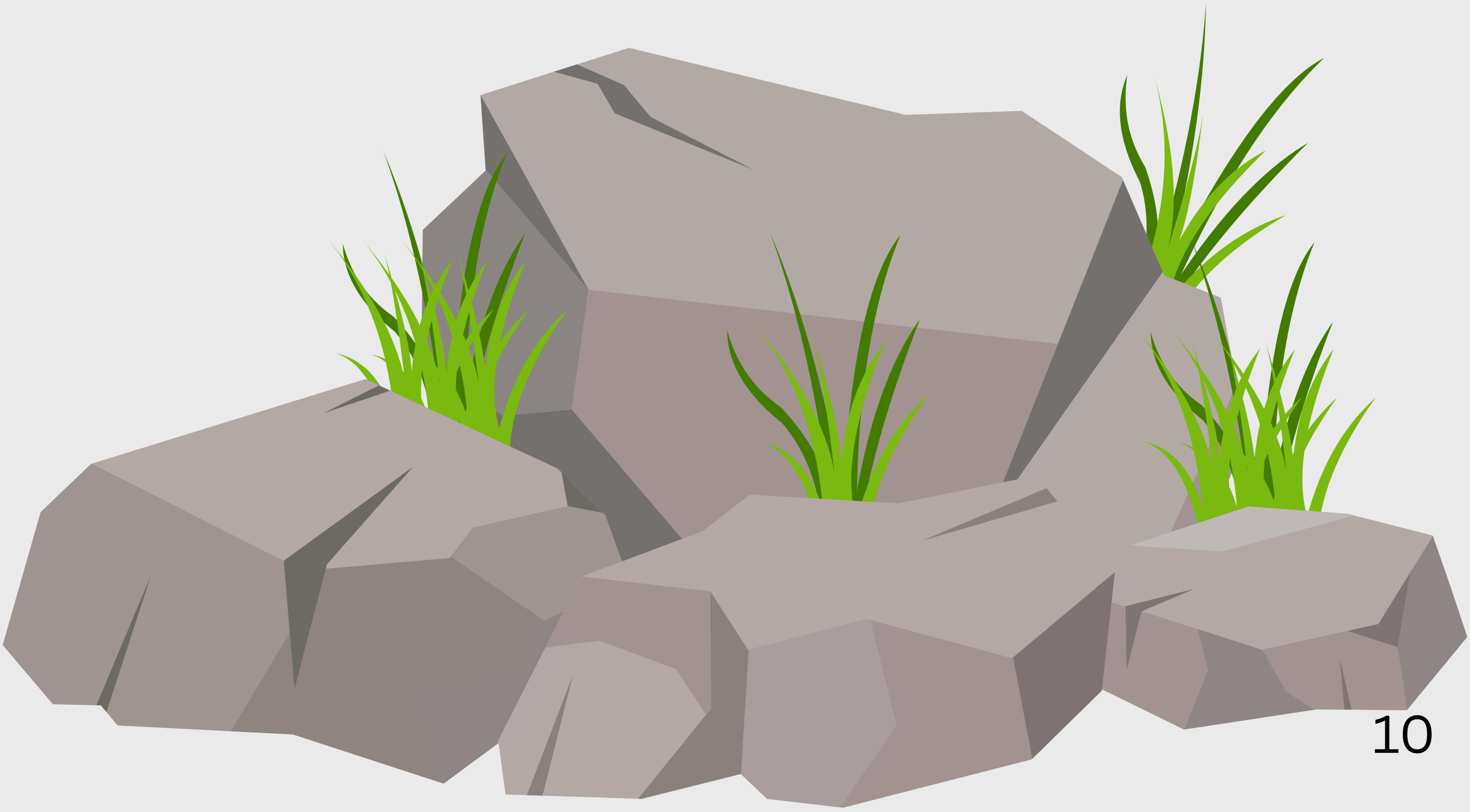
- Rock samples (or printed images if samples are not available)
- Magnifying glasses
- Simple rock identification chart (teacher-made)
- Worksheets for classification
- A3 sheet for rock cycle diagram
- Colors/markers
- Short video (optional)

Learning Activities:

A. Warm-up (5 minutes)

"*What's under our feet?*"

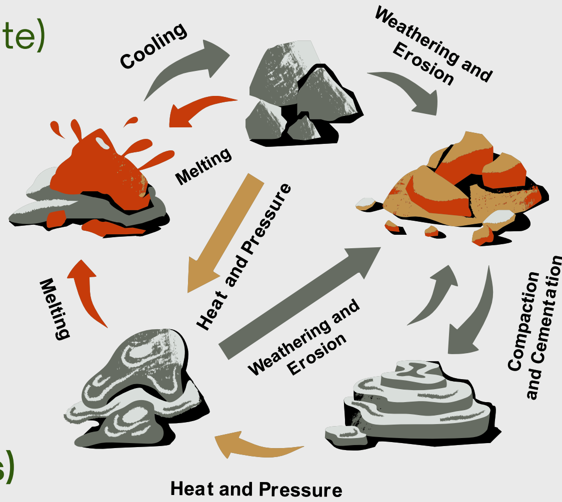
- Teacher shows 3 pictures: granite, sandstone, marble.
- Students guess: *What are these? How are they different?*



B. Mini-Lesson: Input (10 minutes)
Teacher explains:

- What minerals are (examples: quartz, mica, calcite)
- How minerals combine to form rocks
- Types of rocks:
  - Igneous (intrusive/extrusive)
  - Sedimentary (layers, fossils)
  - Metamorphic (heat and pressure)
- Short explanation of the rock cycle

Visual support: a simple slide or printed diagram.



C. Activity 1 — Rock Classification Lab (20 minutes)
Hands-on small-group activity
Steps:

1. Students receive 4–6 rock samples (or photos).
2. Using a simple observation chart, they must identify:
   - Texture (smooth/rough)
   - Grain size
   - Color
   - Presence of crystals/layers
3. Each group decides which type of rock each sample is.
4. Teacher circulates and assists.

Outcomes:
Students learn to classify rocks based on observable characteristics.

D. Activity 2 — Build Your Own Rock Cycle Diagram (15 minutes)
Groups create a **visual model** showing:

- magma → igneous rock
- weathering → sediments → sedimentary rock
- heat & pressure → metamorphic rock
- melting → magma again

Each group quickly presents their diagram.

E. Wrap-up & Reflection (5 minutes)
Students answer:

- *Which rock type is easiest to recognize?*
- *What surprised you about how rocks form?*

Teacher highlights that rocks record Earth's history and link to later lessons on fossils and geologic time.

Assessment

✓ Observation during classification
✓ Group diagram accuracy
✓ 3 exit-ticket questions:

1. *Name one type of rock.*
2. *What process forms sedimentary rocks?*
3. *What is the rock cycle?*

Extensions (optional)

- Virtual museum tour (e.g., Smithsonian mineralogy hall)
- Bring-a-rock homework assignment
- Create-your-own-fossil activity next lesson

Cross-Curricular Links

- **Chemistry** – mineral composition
- **Art** – drawing textures, creating labeled diagrams
- **Geography** – real maps showing areas rich in different rock types

LESSON PLAN

NATURE JOURNALING AND OBSERVATION

Title of the lesson:

Nature Journaling: Observing Biodiversity Around Us

Curriculum Unit:

Unit 2 — Ecology and Biodiversity
Lesson 2.1 — Nature journaling and observation

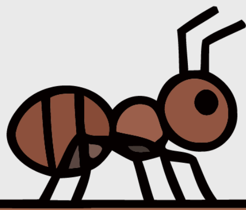
Duration:

1 learning session (50 minutes)

Learning objectives:

By the end of this lesson, students will be able to:

- Observe natural elements with attention to detail.
- Record observations about plants, animals, textures, and patterns.
- Use a journal to document findings through drawings and short notes.
- Identify basic components of local biodiversity.
- Reflect on the relationship between humans and nature.



Key concepts:

- *Biodiversity* = variety of living organisms
- Observation skills
- Nature journaling as a scientific + artistic practice
- Plant/animal features, textures, shapes
- Local ecosystems

Materials needed:

- A5 or A4 notebooks / simple folded paper booklets
- Pencils, colored pencils
- Magnifying glasses (optional)
- Leaves, stones, seeds, bark pieces (if lesson is indoors)
- Mobile devices for taking photos (optional)
- Clipboard for outdoor journaling

Learning Activities:

A. Warm-up (5 minutes)

Teacher asks:
"When was the last time you observed something in nature closely?"
Students share: a plant, an insect, clouds, a tree, etc.
Teacher shows a picture of a leaf and asks:
"How many details can you notice in 10 seconds?"

B. Mini-Lesson: What is Nature Journaling? (10 minutes)
Teacher presents:
- *Nature journaling* = a way to observe, think, and record the natural world
- Used by biologists, explorers, artists, and geographers
- Journaling steps: **Look – Think – Record**
- Demonstration:

Teacher shows a model journal page (simple drawing + notes: colors, shape, location, date, weather).

C. Activity 1 —Observation Walk or Indoor Station (20 minutes)
Two options, depending on school environment:
Outdoor version:
Students go outside (school yard, garden, park) for 10–15 minutes.
They choose one natural element (plant, stone, insect, tree bark) and observe it closely.
They record in their journals:

- Sketch (shape, texture)
- Colors
- Size (approx.)
- Smell, sound (if applicable)
- Location
- *I wonder…*" questions

Indoor version:
Teacher prepares tables with natura objects (leaves, pinecones, stones).
Students rotate between stations and journal 2–3 objects.

D. Activity 2 — Activity 2 — Reflection and Sharing (15 minutes)
Small groups share journal entries:
- *What did you observe?*
- *What surprised you?*
- *What questions do you have?*
- *Why is this organism/object important in nature?*

Teacher introduces the idea that **biodiversity is visible everywhere** if we slow down and observe.

E. Wrap-up & Reflection (5 minutes)
Students write one sentence in their journals:
"*Today I discovered that nature…*"
Teacher highlights that nature journaling is used in future units as well.

Assessment

✓ Observation of student engagement
✓ Journal entry (drawing + notes)
✓ Exit ticket:

1. *Name one benefit of observing nature.*
2. *What detail did you notice that you usually ignore?*

Extensions (optional)

- 1-week "*Daily Nature Journal Challenge*"
- Create a class "*Biodiversity Wall*" with samples (photos, sketches)
- Compare two habitats (garden vs. urban sidewalk)
- Digital journaling using the EMME Mobile App (photo + notes section)

Cross-Curricular Links

- **Biology –** ecosystems, plants, insects
- **Art –** sketching, shading, texture
- **Geography –** landforms, microhabitats
- **Language arts –** descriptive writing

LESSON PLAN
GEOPARKS: UNIQUE PLACES OF EARTH'S AND HUMAN MEMORIES TO BE DISCOVERED

Title of the lesson:

Discovering Geoparks: Earth's Stories and Human History in One Place

Curriculum Unit:

Unit 3 — Environmental Stewardship
Lesson 3.3 — Geoparks – unique places of Earth's and human memories

Duration:

1 learning session (50 minutes)

Learning objectives:

By the end of this lesson, students will be able to:

- Explain what a UNESCO Global Geopark is.
- Describe the role of geoparks in protecting geological heritage and cultural identity.
- Identify examples of geological and cultural landmarks from at least one partner geopark.
- Understand the connection between environmental stewardship and geoconservation.
- Reflect on how humans shape, protect, and remember landscapes.

Key concepts:

- Geological heritage
- Cultural heritage
- Geoconservation
- Sustainable development
- Geostories / Earth memory
- UNESCO Global Geoparks Network

Materials needed:

- Images / videos of geoparks (Hațeg, Azores, etc.)
- A world or Europe map
- EMME Mobile App (optional – for the "Meet your Geoparks" section)
- Projector or printed fact cards
- Worksheets for student reflections
- Sticky notes, markers

Learning Activities:

A. Warm-up (5-7 minutes)
Teacher asks students:
"*What is the most interesting natural place you have ever visited? What story do you think that place tells?*"
Students share impressions. Teacher introduces the idea that some places keep the memory of the Earth — these are geoparks.

B. Mini-Lesson: What Is a Geopark? (10 minutes)
Teacher explains:

- A UNESCO Global Geopark is a territory with:
  - geological sites of international importance
  - cultural, historical, and ecological value
  - strong community involvement
  - sustainable tourism and education programs

Teacher shows 2–3 short clips or photos from Hațeg Geopark and Azores Geopark.
Key question:
"How can a place be both a geological book and a cultural museum?"
Students brainstorm.

C. Activity 1 — Exploring Geoparks (10 minutes)
Students work in groups (Romania, Portugal, Croatia, Slovakia versions):
Each group receives:

- A set of cards with geological sites
- Cards with cultural elements (myths, traditions, historical objects)
- A short description of a partner geopark

Groups complete a mini-task:
"Match the geological memory with a human memory."
Examples:

- Fossil dwarf dinosaurs ↔ Densuș stone church architecture
- Volcanic fumaroles ↔ Azorean traditional food cooked in geothermal heat
- Stone tools ↔ Traditional mining culture
- Karst landscapes ↔ Local myths and legends

The group prepares a quick poster or slide:
"Our geopark tells the story of…"

D. Activity 2 — Geoparks in the EMME App (optional, 10 minutes)
Using the mobile app section "*Meet your Geoparks*", students explore:

- Map location
- Key geological sites
- Cultural heritage examples
- Photos + descriptions

discover

Task:
Students identify one site they would love to visit and write a short explanation why.

E. Reflection & Discussion (10 minutes)

Teacher guides a whole-class conversation:

- *Why do geoparks matter?*
- *How do they protect the environment?*
- *How do they support communities?*
- *How do they help students connect with the Earth's memory?*

Students write on sticky notes:
"One memory of the Earth I want to protect is…"
Notes are posted on a classroom board.

Assessment

- Group task: matching geological + cultural elements
- Poster/slide describing the geopark
- Reflection sticky note
- Optional rubric assessing understanding of geopark functions

Extensions (optional)

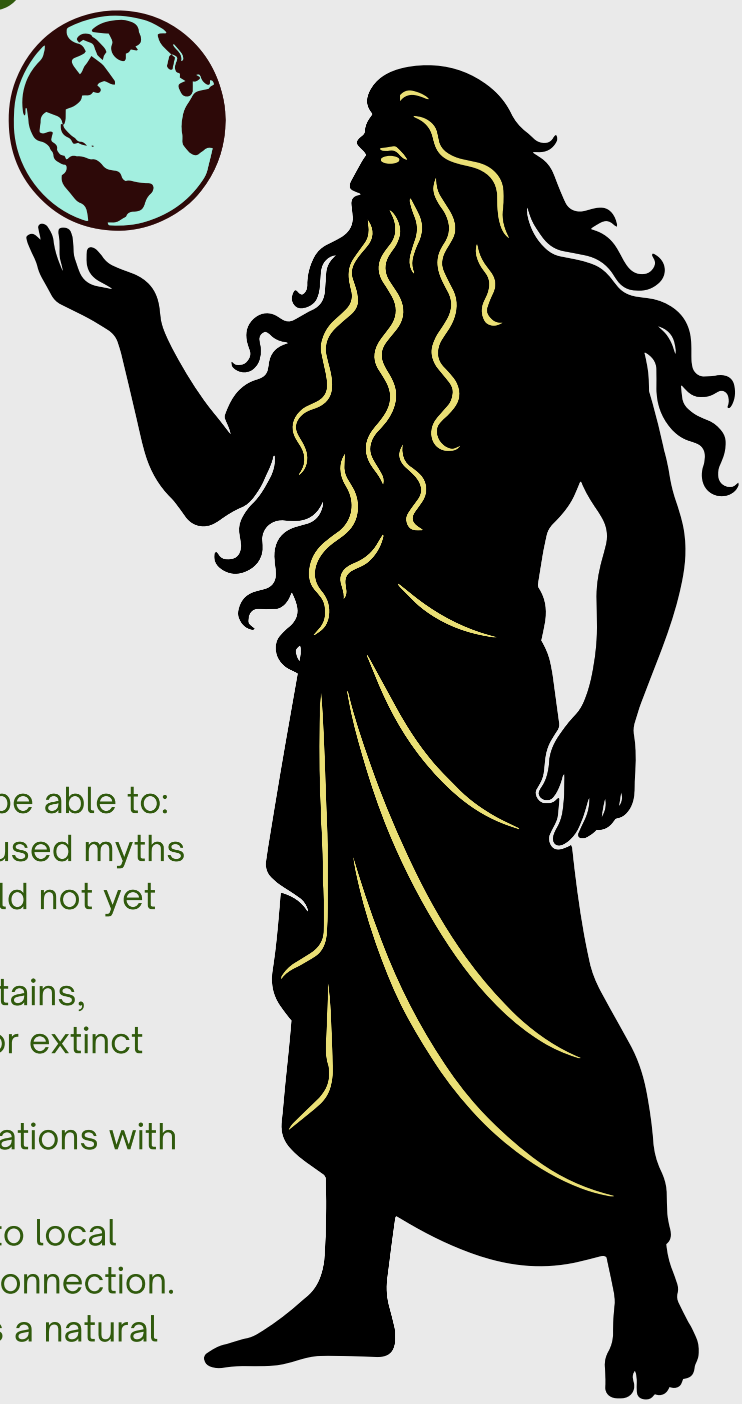
- Create a class exhibition: "*My Geopark Story*"
- Field trip to a local natural site
- Virtual tour of Hațeg or Azores
- Photo-journaling activity using the app
- Research one geological site close to home

Cross-Curricular Links

- **Geography** – landforms, ecosystems
- **History** – human settlements, traditions
- **Art** – creating posters, visual storytelling
- **Civic education –** environmental responsibility
- **Digital skills –** using the EMME mobile app

LESSON PLAN

LOCAL MYTHOLOGY RELATED TO EARTH PROCESSES



Title of the lesson:

Earth Stories: How Local Myths Explain Natural Phenomena

Curriculum Unit:

Unit 4 — Local History and Culture
Lesson 4.3 — Local mythology related to Earth processes

Duration:

1 learning session (50 minutes)

Learning objectives:

By the end of this lesson, students will be able to:

- Describe how ancient communities used myths to explain Earth processes they could not yet understand scientifically.
- Identify local myths related to mountains, caves, rivers, stones, earthquakes, or extinct animals.
- Compare traditional mythical explanations with modern scientific interpretations.
- Explain how mythology contributes to local cultural identity and environmental connection.
- Create an original myth that explains a natural landform or process in their region.

Key concepts:

- Mythology
- Oral tradition
- Local identity
- Geological processes
- Storytelling
- Cultural heritage

Materials needed:

- Examples of local myths (Romania, Portugal, Croatia, Slovakia)
- Printed mythology cards
- Images of local landforms or fossils
- A short video clip (optional) about myths explaining natural events
- Worksheets for comparison charts
- Colored pencils, markers

Learning Activities:

A. Warm-up Activity - "Guess the Natural Process" (5 minutes)

Show students pictures of:

- a volcano
- an earthquake crack
- a mountain peak
- a cave
- an unusual rock formation

Ask:

"If you lived 3,000 years ago, how would you explain this?"

Students imagine quick explanations.

Introduce the idea that myths were humanity's first science — attempts to describe Earth processes.

B. Mini-Lesson: Myths as Early Science (10 minutes)

Teacher explains:

- Before scientific knowledge, people created stories to explain earthquakes, storms, fossils, and mountains.
- Myths include gods, giants, dragons, spirits, and legendary heroes.
- Many myths are linked to real geological phenomena.

Show examples:

- Romania (Hațeg): Balaurii, fiery creatures explaining volcanic rocks and dinosaur bones
- Portugal (Azores): Goddess Io, creator of the volcanic islands
- Croatia: myths about stone giants shaping the mountains
- Slovakia: karst spirits living in caves

Key question:

"*What Earth memory is hidden in each story?*"

C. Activity 1 — Myth vs. Science Chart (15 minutes)

Students work in 4 groups.

Each group receives a myth card and a geoscience explanation card.

Example pairs:

- Myth: "*Dragons under the mountains cause earthquakes.*"
- Science: Tectonic plates shifting at fault lines.
- Myth: "*Volcanoes erupt because gods inside are angry.*"
- Science: Pressure of magma chambers.
- Myth: "*Giants built the mountains.*"
- Science: Fold mountains formed by plate collision
- Myth: "*Stone figures were once people turned to rock.*"
- Science: Erosion shaping rock formations.

Groups complete a chart:

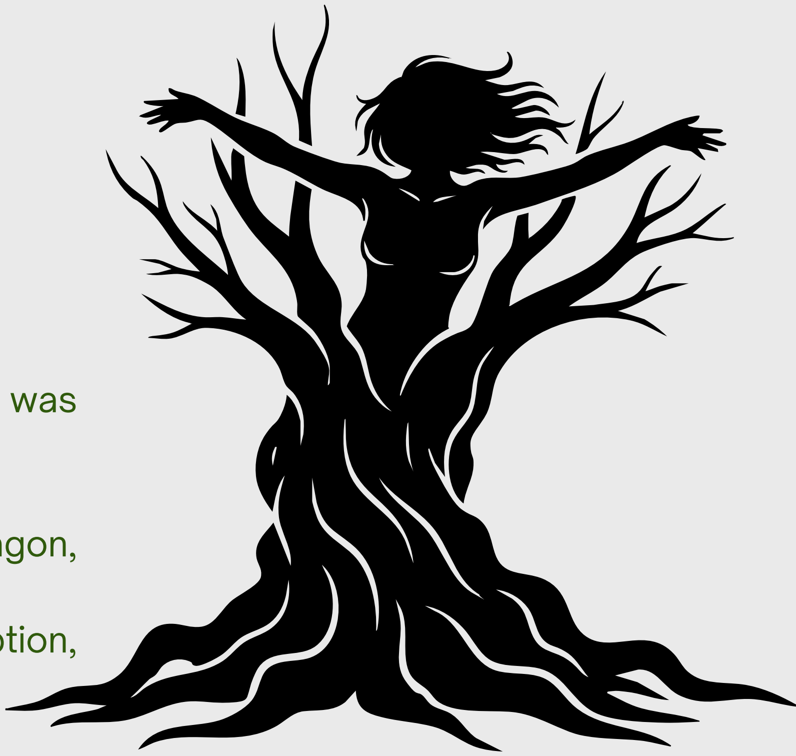
Myth Explanation	Scientific Explanation	Common Elements
...	...	both show Earth as alive, powerful, meaningful

Groups present in 1 minute.

D. Activity 2 — Create Your Own Earth Myth (15 minutes)

Students choose a local landform:

- a river
- a hill or mountain
- a cave
- a valley
- an unusual rock
- a fossil found in their area



Task:

Write a short myth explaining how it was created.

Must include:

- 1 magical character (spirit, dragon, hero, god)
- 1 natural phenomenon (eruption, erosion, earthquake, flood)
- 1 moral or lesson

Students may also illustrate their myth.

E. Sharing & Reflection (5–10 minutes)

Volunteers read their myths.

Teacher leads a discussion:

- *Why did people give human emotions to natural phenomena?*
- *How do myths help us connect with our landscape?*
- *How does science deepen this understanding rather than replace it?*

Students complete the sentence: “*The story of my landform teaches me that…*”

Assessment

✓ Completed Myth vs. Science comparison chart
✓ Quality and creativity of original myth
✓ Participation in discussion
✓ Understanding of connection between culture and geology

Optionally, students upload written myths in the EMME App or publish them as class stories.

Extensions

- Create a digital illustrated myth using Canva or StoryJumper
- Record a video storytelling performance
- Build a class booklet: *Earth Legends of Our Region*
- Integrate myths into a guided tour of local geological sites

Cross-Curricular Links

- **Literature** – storytelling, oral traditions
- **History** – ancient beliefs and worldviews
- **Geography/Geology** – landforms, earthquakes, volcanoes
- **Art** – illustrated myths
- **ICT** – digital storytelling tools

LESSON PLAN

MAPPING THE 4D ENVIRONMENT: 2D, 3D & 4D REPRESENTATIONS OF LANDFORMS AND OBJECTS

Title of the lesson:

Seeing the Earth in 4 Dimensions: From Maps to Time-Evolving Landscapes

Curriculum Unit:

Unit 5 — Mapping and Spatial Skills
Lesson 5.2 — Mapping the 4D environment

Duration:

1 learning session (50 minutes)

Learning objectives:

By the end of this lesson, students will be able to:

- Interpret topographic contour lines on a 2D map.
- Understand how 3D models represent elevation, relief, and spatial structure.
- Explain what 4D mapping means by adding the time dimension.
- Identify real examples of landscapes that have changed significantly over time.
- Create simple 2D/3D/4D representations of a local landform using classroom tools or digital resources.

Key concepts:

- Topography
- Contour lines
- Elevation
- 3D spatial modeling
- 4D (time evolution)
- Digital mapping
- Landscape change

Materials needed:

- Printed simple topographic map or schoolyard/sketch
- ADEM / Google Earth / Mapy.cz screenshots (optional)
- Clay, cardboard, or plasticine for 3D modeling
- Rulers, compasses, markers
- Worksheets for 2D → 3D → 4D transition
- Printed or digital photos showing landscape change over time (e.g., river migration, glacial retreat, deforestation)

Learning Activities:

A. Warm-up - "Which Map Shows the Real Shape?" (5 minutes)

Teacher shows 3 images of the same hill:

- A photo
- A topographic map with contour lines
- A simple 3D model illustration

Students guess:

"Which one is correct? Which one is the most informative?"

Introduce the idea that each representation tells something different.

B. Mini-Lesson: Understanding 2D, 3D, and 4D Mapping (10 minutes)

Teacher explains:

- 2D Mapping
  - Flat representation using contour lines.
  - Contour lines = points at same elevation.
  - Close lines = steep slope; distant lines = gentle slope.
- 3D Mapping
  - Shows height and depth directly.
  - Useful for visualizing valleys, peaks, river channels.
  - Built through models, DEMs, lidar, drone mapping.
- 4D Mapping
  - 3D + time.
  - Shows how a landscape changes through erosion, sedimentation, tectonic movement, sea level rise, glacier retreat, human construction.

Show real examples:

- Danube Delta growing over centuries
- Glacial retreat in the Alps
- A river shifting course
- Deforestation affecting a slope
- Eruptions building a volcanic cone

Essential question:

"*What story does this landscape tell if we look at it through time?*"

C. Activity 1 — Build a Mini Topographic Map (2D) (10 minutes)

Students receive a simple line drawing of a hill or valley OR sketch one from the schoolyard.

Tasks:

- Add contour lines at regular intervals.
- Label elevation (e.g., 10m, 20m, 30m).
- Identify steep vs. gentle slopes.

Optional challenge: hide a "*mystery object*" (a lake, a cliff, a crater) within the contours.

D. Activity 2 — Create a 3D Model (10–15 minutes)

Using clay/cardboard, students transform their 2D map into a 3D shape.

Steps:

1. Cut out elevation layers, stack them like a cake.
2. Smooth the model to approximate the real shape.
3. Compare models between teams.

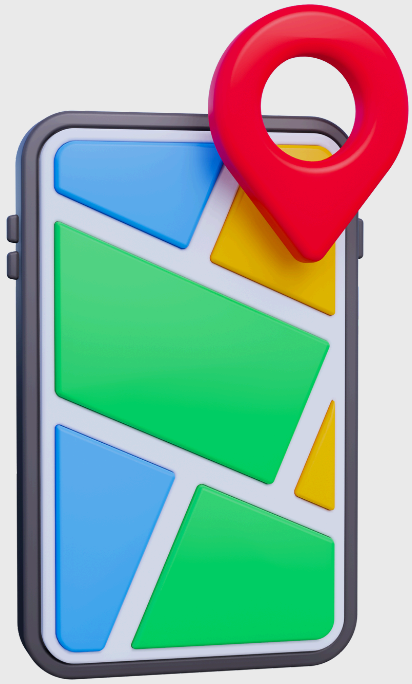
Reflection prompt:

"*What did the 3D model show you that the map didn't?*"

E. Activity 3 – Draw a 4D Timeline (10 minutes)

Students choose a real landscape process:

- river meandering over time
- mountain erosion
- dune migration
- glacial advance/retreat
- landslide development
- volcanic cone growth
- coastal erosion



Task:

Create a 3-panel evolution sketch showing:

1. Past
2. Present
3. Future

Each panel must include:

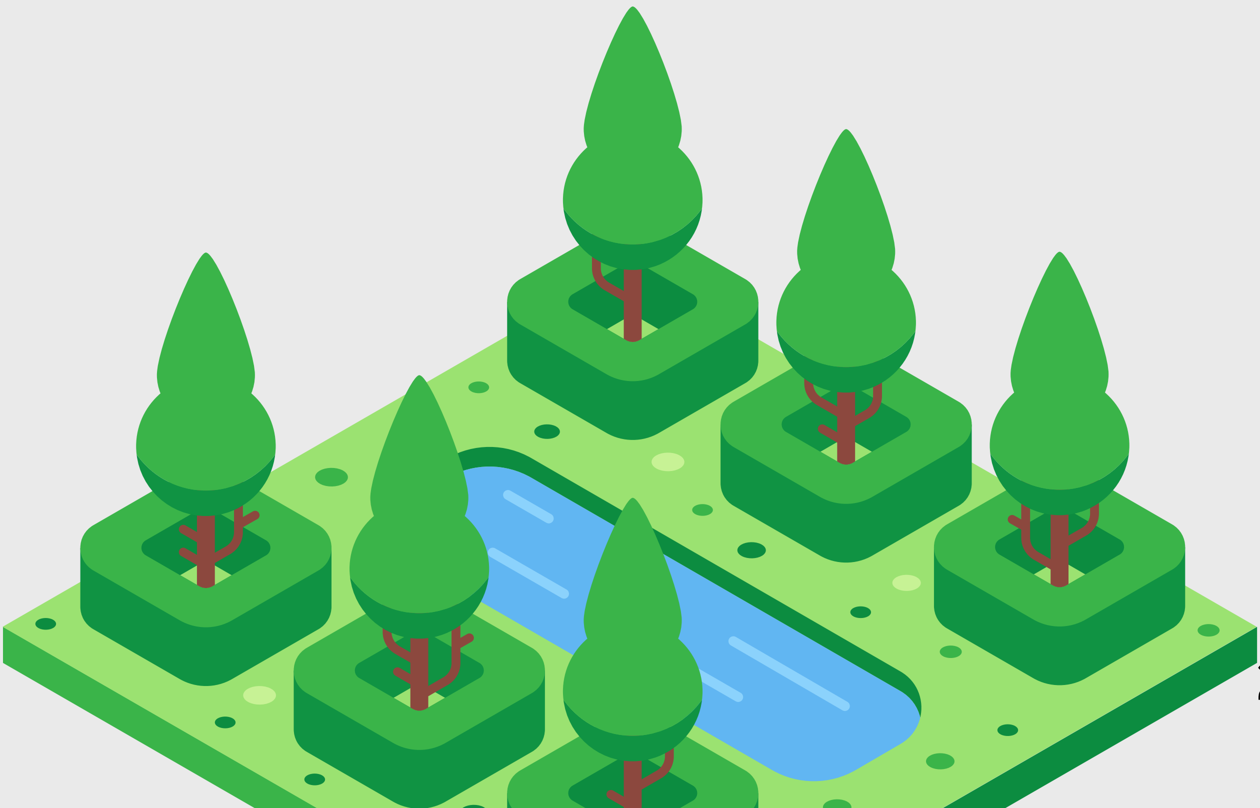
- Changes in shape
- Changes in materials
- Indicators of natural processes

F. Sharing & Reflection (5 minutes)

Students present models or 4D timelines.

Discussion questions:

- Which representation (2D/3D/4D) helped you see the landscape most clearly?
- How does the time dimension change our understanding of places?
- Why do scientists need all three types of mapping?



Assessment

✓Completed topographic map with correct contour logic
✓3D model accuracy
✓4D timeline illustrating realistic geological processes
✓Participation in discussions

Extensions

- Create a digital 3D model with Tinkercad or SketchUp
- Use Google Earth’s timeline slider for real 4D mapping
- Build a classroom relief map of the region
- Students create a “*landform passport*” including its birth, evolution, and future

Cross-Curricular Links

- **Geography** – landforms, mapping
- **Geology** – erosion, tectonics, sedimentation
- **Math** – scale, elevation, spatial reasoning
- **ICT** – digital modeling
- **Art** – 3D sculpting, sketching landscapes

AUTHORS TEAM

CCoordinators team from UNIVERSITATEA DIN BUCUREȘTI, RO

- Alexandru Andrăşanu
- Maria Tănăsescu
- Cristian Ciobanu
- Adina Popa
- Dan-Horațiu Popa

Contributors Team from Geoaçores - Associação Geoparque Açores, PT

- Salomé Meneses Costa
- André Borralho

Contributors Team from Liceul Teoretic „Avram Iancu” Brad, RO

- teacher Ștefan Bogdan-Mihai
- teacher MIheț Monica-Ancuța
- teacher Fărău Adrian
- teacher Stan Daniela
- teacher Selagea Violeta-Ramona

Contributors team from Escola Secundária Jerónimo Emiliano de Andrade, PT

- teacher Marisa Dias
- teacher Ana Simas
- teacher André Pereira

Contributors Team from Osnovna skola Pantovcak, HR

- teacher Daniela Žižanović,
- teacher Danijela Takač,
- teacher Tatjana Pešić - Ilijaš,
- teacher Đurđica Miškulin

Contributors team from ZSHutnicka 16, Spisska NovaVes, SK

- teacher Eva Školníčková
- teacher Romana Melikantová
- teacher Magdaléna Jendrálová

Publication layout

- Maria Tănăsescu
- Miheț Monica-Ancuța

REFERENCES

Core Geoscience & Geology

- National Geographic Society. (2021). *What is Geology?* National Geographic Resource Library.
- American Geological Institute. (2016). *Earth Science Literacy Principles: The Big Ideas and Supporting Concepts of Earth Science.*

Ecology, Biodiversity & Environmental Stewardship

- Convention on Biological Diversity (CBD). (2020). *Global Biodiversity Outlook 5.* Montreal: Secretariat of the CBD.
- World Wildlife Fund (WWF). (2022). *Living Planet Report.* Gland, Switzerland.

UNESCO & Geoparks Framework

- UNESCO. (2017). *Education for Sustainable Development Goals: Learning Objectives.* Paris: UNESCO.
- UNESCO Global Geoparks. (2022). *Guidelines for Geopark Education and Public Engagement.* UNESCO Earth Sciences Division.

Cultural Heritage & Local History

- UNESCO. (2003). *Convention for the Safeguarding of the Intangible Cultural Heritage.* Paris: UNESCO.
- Smith, L. (2006). *Uses of Heritage.* Routledge.

Cartography, Mapping & Spatial Skills

- International Cartographic Association (ICA). (2019). *Cartography and Children: Educational Resources.*
- National Geographic Society. (2019). *Map Skills for Life: Using Maps to Understand Our World.*

Pedagogical Foundations

- Dewey, J. (1938). *Experience and Education.* Macmillan.
- Kolb, D. (1984). *Experiential Learning: Experience as the Source of Learning and Development.* Prentice-Hall.

Project-Specific Materials

- **EMME – Exchanging Memories: Memory of the Earth.** (2023–2025). Project documentation & curriculum resources. **Erasmus+ Project No. 2023-1-RO01-KA220-SCH-000166887.**

PROJECT NO. **2023-1-RO01-KA220-SCH-000166887**

PROJECT TITLE: **EXCHANGING MEMORIES - MEMORY OF THE EARTH**

CALL: **ERASMUS+-KA220-SCH-2023**

DURATION: **24 MONTHS**

DELIVERABLE TITLE: **#EMME CURRICULUM - TEACHER IMPLEMENTATION GUIDE**

DISSEMINATION LEVEL: **PUBLIC**

DELIVERABLE LEAD: **UNIVERSITATEA DIN BUCURESTI**

WORK PACKAGE: **WP2**

Funded by
the European Union

Co-funded by
the European Union

GEOPARQUE AÇORES

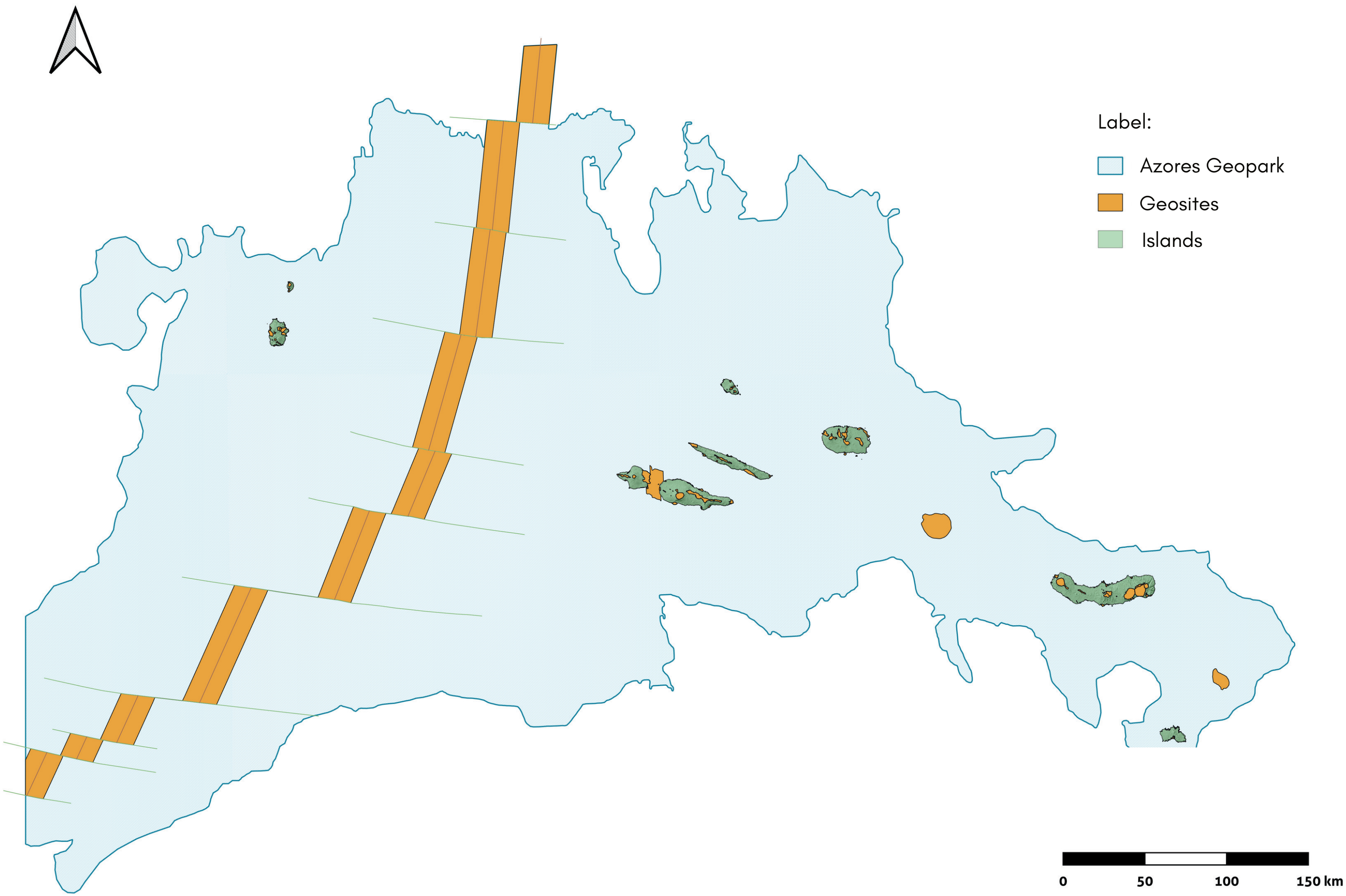
unesco
Global Geopark

EXCHANGING MEMORIES
- MEMORY OF THE EARTH -

FIELD NOTEBOOK
STAFF TRAINING IN PORTUGAL

ERASMUS+ KA220-SCH-2023
COOPERATION PARTNERSHIPS IN SCHOOL EDUCATION PROJECT DURATION:
1.10.2023 - 30.09.2025
PROJECT CODE: 2023-1-RO01-KA220-SCH-00166887

AZORES UNESCO GLOBAL GEOPARK TERRITORY



The boundary of the Azores Geopark corresponds to the 2000 m bathymetric line (blue on the map)

EXCHANGING MEMORIES - MEMORY OF THE EARTH -

The **EMME** project, *Exchanging Memories – Memory of the Earth*, is an innovative project that, for the first time, involves **GEOPARKS** and **SCHOOLS** from various territories.

The Memory of the Earth is written in rocks and landscapes, millions of years of history that allow us to better understand and respect our planet. The project concept "**THE MEMORY OF THE EARTH**" will allow the students involved to discover the geological history of these territories and the importance of the geological record. The main goal is to increase knowledge and awareness on geological and environmental conservation, through activities carried out in collaboration with UNESCO Global Geoparks (Azores and Hateg). At the same time, it promotes sustainable practices, interactive learning and develops green skills/competences, for a more harmonious existence and connection with Mother Earth.

Tangible results include the #EMME curriculum "Memory of the Earth", "#EMME goes digital" mobile application, video documentaries on "#EMME around the world", as well as project logo, articles in the local press, project website, social media pages, eTwinning page, eTwinning conferences, follow-up events, etc.

Intangible results will include a strengthened partnership between schools and geoparks, offering more engaging, relevant, and meaningful educational experiences for students.

UNDERSTANDING THE PAST IN ORDER TO BETTER PREPARE FOR THE FUTURE.

Co-funded by the European Union

Erasmus+

SUSTAINABLE DEVELOPMENT GOALS

The journey through geological time and the discovery of the "Memory of the Earth" contributes to the **Sustainable Development Goals** (SDGs).

The SDGs are a United Nations (UN) initiative that aims to address interconnected problems such as poverty, hunger, health, education, gender equality, clean water, sanitation and peace. There are 17 ambitious goals, each with specific targets, which seek to create a more sustainable planet and improve the quality of life for everyone.

The **EMME** Project contributes to:

4 QUALITY EDUCATION

Creating a different learning approach and experience to better connect the students and teachers to their nearby environment. Enabling outside activities, cultural exchange, and promote applied research in Earth Sciences with the objective of empowering this new generation.

13 CLIMATE ACTION

Students understanding their own surrounding environment, framed in a Planet scale, for a better understanding of the climate change causes and consequences. Empowering them to efficiently fight climate change in their own areas and adopt innovative ways of living for a greener future.

15 LIFE ON LAND

Geodiversity is the base of life on Earth. It underpins all our environments and ecosystems, and unless we conserve geodiversity, then we cannot protect biodiversity. The project will contribute to valuing and protecting ecosystems, including their biodiversity.

17 PARTNERSHIPS FOR THE GOALS

International cooperation is vital for securing progress towards the sustainable development goals. Through international institutions like the UN, UNESCO, the UNESCO Global Geopark community, and our schools, we can facilitate progress together as a global community.

STAFF TRAINING - PROGRAM

MEETTING IN TERCEIRA - AZORES

FRIDAY | June 21st

ARRIVAL DAY

SATURDAY | June 22nd

WELCOME DAY

12h30: Lunch at Café Aliança

16h00: Reception at the headquarters of the "Os Montanheiros" association

Dinner: Sanjoaninas Tascas

SUNDAY | June 23rd

STAFF Training Activities

09h00: Urban Geo Route
[Meeting point | São Sebastião Fort]

11h00: Visit to Quinta do Martelo

13h00: Lunch at Quinta do Martelo

16h00: Visit to the City Hall and to Angras' Museum

19h30: Dinner at Birou Bar

MONDAY | June 24th

FREE DAY

19h30: Dinner at Beira Mar – Angra

TUESDAY | June 25th

STAFF Training Activities | *Azores Geopark Island Delegation*

09h00: Staff Training held by the Azores UNESCO Global Geopark

- Geographical and geological context of the Azores.
- Educational potential of the Azores Geopark.

10h30: Coffe break

12h30: Lunch at BioAzórica

14h00: Staff Training held by the Azores UNESCO Global Geopark

- Educational Resources

19h30: Dinner at Taberna do Fado

WEDNESDAY | June 26th

STAFF Training Activities | *ESJEA*

09h00: Project Meeting
10h00: Staff Training held by the Azores UNESCO Global Geopark
- Presentation of Children's guides produced by the Azores Geopark

10h30: Coffe break
12h30: Lunch at Sala 319

14h00: Staff Training held by the Azores UNESCO Global Geopark
- Students Presentation about the tasks performed related to the children's guides.

16h00: Project Meeting
19h30: Dinner at Beira Mar de São Mateus

THURSDAY | June 27th

Island TOUR Day

08h50: Meeting place at ESJEA main entrance
09h00: Geosites route with Azores UNESCO Global Geopark
- Monte Brasil
- Serra do Cume + Lajes Graben
- Alagoa da Fajãzinha
- Pico Matias Simão

13h00: Lunch at Bagulho Restaurant
- Algar do Carvão
- Furnas do Enxofre [expect wet pavement and mud, we advise to wear raincoat because of water drops on the cave]

17h00: Cheese tasting at cheese factory - Queijo Vaquinha
19h30: Dinner at Marina Grill

FRIDAY | June 28th

DEPARTURE DAY

CURRICULUM

STRUCTURE OF #EMME CURRICULUM

U1 - Geology and Paleontology

- ***Earth's building materials / Basic Geologic Processes*** – Planet Earth; Earth materials (minerals, magmatic, metamorphic and sedimentary rocks); rock cycle.
- ***How it works*** – Plate tectonics / Mountains building and destruction / Volcanoes & Earthquakes.
- ***Earth 4,54 billion years memory*** – The Deep Time / Fossils and rocks memories / Geologic Time Scale; life evolution and fossil evidences; Earth through time (the lost worlds); how to measure the age of rocks; how to reconstruct past environments.

U2 - Ecology and Biodiversity - The back yard nature

- ***Nature Journaling and Documentation*** – Nature walks and observation / Ecosystems and habitats.
- ***Investigating Soil and Water*** – Water quality testing in ponds and rivers to assess pH, clarity, and the presence of aquatic life.
- ***Nature-Based Art and Creativity.***
- ***Culinary Adventures with Backyard Bounty*** – plants and herbs from the backyard to create local simple recipes, connections between food, health and nature.
- ***Learning about sustainable gardening practices.***
- ***Permaculture.***

U3 - Environmental Stewardship

- ***Memory of the Earth*** – Digne Declaration.
- ***Geological heritage*** – the best memories of the earth / management and governance.
- ***Geoparks*** – unique places of earth s and human memories to be discovered.
- ***Meet your geoparks*** – examples of geoparks from Romania, Portugal, Slovakia and Croatia. European Geoparks family.

U4 - Local History and Culture

- ***The dialogue between man and earth*** – local raw materials and resources.
- ***Stone made objects*** – Most of the objects surrounding us – either valuable or everyday items–use rocks and minerals as their raw materials reveal many stories: A geological story, about how natural processes have generated specific rocks. Millions or hundreds of millions of years passed from the formation of the raw material until the moment when people turned it into an object; An anthropological story, helping to create a sense of place and unique identity; and a socio-economic story of how local communities have used geological resources to create objects for use or ornamentation and develop a local or international industry.
- ***Local mythology related to Earth processes*** – Local mythology often intertwines with natural phenomena and Earth processes, providing explanations and narratives for various phenomena.
- ***Stone made objects in local archeology and architecture.***

U5 - Mapping and Spatial Skills

- ***Local geomorphology*** – Introducing landforms and landscapes.
- ***Mapping the 4D environment*** – 2D– topographic mapping of landforms or objects; 3D – the spatial representation of the rock bodies or other objects; 4D – adding the time dimension (evolution in time of a landform/landscape/object).

Field applications
– identify the basic rules when interact with nature / rules / prepare a field application (cloths, itinerary – how to use a map (different types of maps), basic instruments (nature observation kit – compass, lens, etc).
– small research projects initiatives such as rocks identification, trees, bird counts, butterfly surveys, or plant tracking – data collection and graph representation while engaging in outdoor activities.
– Visit your geopark to discover the Earth's Memory.

UNESCO
GLOBAL GEOPARKS

UNESCO Global Geoparks are unique places on Earth. They are areas with an internationally **recognized geological heritage**, where science and local communities unite in mutual benefit. They are territories of resilience, that promote knowledge of the Earth's memory, read in the rocks, landscape and geological processes.

213	48	60	1
UNESCO Global Geoparks	Nations	Millions of visitors/year	Network

AZORES
UNESCO GLOBAL GEOPARK

The natural and cultural identity of the Azores is internationally recognized for its authenticity. With a geological heritage of excellence, the territory composed of 9 islands and surrounding marine area, integrated the **Global and European Geoparks Networks** in 2013. In 2015, with the approval of the UNESCO International Geosciences and Geoparks Programme, it was recognized as a UNESCO Global Geopark.

Given the archipelagic nature of the Region, the Azores Geopark is based on a network of **121 geosites**, spread across the nine islands and surrounding marine area, which guarantee the representativeness of the geodiversity that characterizes the Archipelago, and reflect its geological and eruptive history.

9 ISLANDS - 1 GEOPARK

The **Azores UNESCO Global Geopark's** mission is to promote the relationship between natural and cultural heritage, taking geodiversity and geological heritage - *the volcanic genesis that characterizes the essence of the Azores* - as its starting point.
The mission is carried out through a holistic approach, integrating the different values associated with the territory and being close to the communities.

Like all geoparks in the world its work is sustained in three main pillars:

CONSERVATION
EDUCATION
SUSTAINABLE DEVELOPMENT

The **EDUCATIONAL ACTIVITIES** and programmes aim to contribute to the consolidation of sustainability concepts, providing essential tools for the knowledge and appreciation of the natural values associated with the territory and cultivating a sense of belonging to the territory and its particularities.

We take this opportunity to present to you some of the activities performed by our geopark, that can be framed in the

Curriculum of EMME Project.

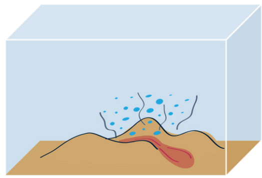
LEARNING WITH VOLCANOES

A volcano forms when **MAGMA**, which comes from the interior of the Earth, reaches the surface and causes an **ERUPTION**, building up through accumulation of emitted materials. There are different types of volcanoes, which are differentiated by numerous factors, such as, the place where they occur, the composition of magma and even the number of times it erupted.

In a very simplified way and considering different factors, we can organize different types of volcanoes as follows:

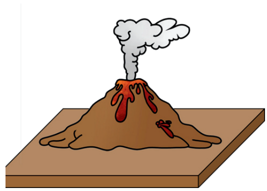
Submarine volcanoes

They form at the bottom of the sea and their eruptions are conditioned by the contact of lava with sea water (e.g. Ilhéu das Cabras; Ilhéus da Madalena; Ilhéu de Vila Franca; Monte Brasil; Monte da Guia or Morro das Velas).



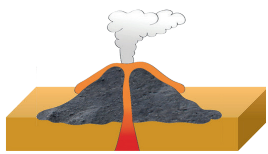
Terrestrial or subaerial volcanoes

They form on land, whether on islands or continents, and the type of associated eruption will depend mainly on the composition of the magma (e.g. Caldeirão; Serra de Santa Bárbara; Monte Queimado or Pico do Carvão).



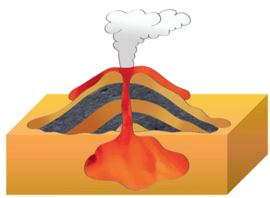
Monogenetic volcanoes or small volcanoes

They result from a single eruption and are normally small ones (e.g. Pico da Sé; Pico do Gaspar or Cabeço Verde).



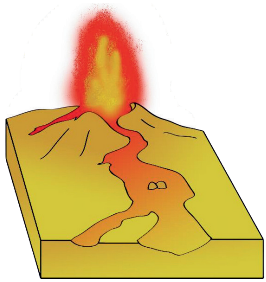
Polygenetic volcanoes or large volcanoes

They are formed following several eruptions that originate a large cone or volcanic edifice, to which secondary cones may be associated (e.g. Pico Alto; Caldeira Volcano; Sete Cidades Volcano or Caldeirão).



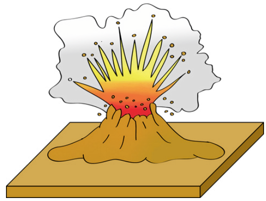
Effusive volcanoes

The volcanic activity associated with these volcanoes is calm and characterized by the emission of lava flows that flow calmly from the emitting source. They can form rivers, lakes or lava fountains.



Explosive volcanoes

The volcanic activity associated with these volcanoes is usually violent, pyroclasts of different shapes and dimensions are emitted, as well as large quantities of gases.



THERE ARE SO MANY VOLCANOES IN THE WORLD!

How important are they to us?
Do they have any importance at all or are they just a cause of concern?

- Volcanoes create unique landscapes, perfect for hicking, photographing, swimming and even cooking;
- Volcanic soil is the best for growing vegetables and fruits;
- The cooling of lava results in different types of rocks (stones), which are widely used to build houses, schools, churches and even roads;
- The heat from volcanoes constitutes an important source of energy (geothermal energy), which can be used to produce electricity or heat greenhouses, among others.

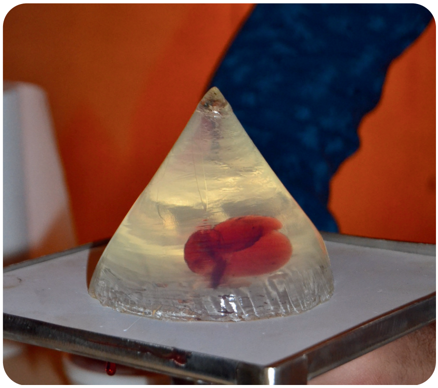
Learn more about volcanoes here
"The volcanoes of the Azores" - Children's Guide - Azores Geopark

JELLY VOLCANO(U1)

This activity aims to represent effusive basaltic *s.l.* volcanic eruptions with the emission of lava flows. As the jelly is transparent, it also allows students to observe the intrusion of magma, creating the volcano's plumbing system with the formation of dikes.

You will need:

- 10 g of powder gelatin
- 250 ml of boiling water
- 250 ml of cold water
- 1 bucket with lid
- 1 plastic bag
- 1 piece of strong cardboard
- 1 syringe
- Strawberry syrup
- 1 straw or plastic tube for syringe



Make your own eruption!

1. Mix the powder gelatin and the boiling water first into a bowl. Add the cold water and mix again;
2. To get a cone shaped volcano, put one of the closed corners of the plastic bag facing down inside the bucket with a lid;
3. Pour the mixed gelatin into the set plastic bag and leave it inside the fridge for 3 hours;
4. In the meantime, make some holes in the middle of the cardboard;
5. Set up your volcano in a way that the strawberry syrup can be pump from underneath the volcano cone;
6. Insert the strawberry syrup into the syringe and attach a straw to the narrow end. Start pumping syrup into the volcano through the holes in the cardboard into the gelatin volcano until it burst out!

EXPLOSIVE VOLCANO (U1)

This experiment aims to represent explosive volcanic eruptions that are characterized by the emission of pyroclasts like ashes, lapilli and bombs. During this kind of eruption the lava is fragmented and projected to the air (accumulation leads to the edification of the volcanic cone).

You will need:

- 75 g of ammonium bichromate
- 9 g of sugar
- 15 cm of magnesium tape
- 15 match heads
- Long reach match sticks
- 1 metal cylinder can

Make your own eruption!

This experiment needs to be supervised by an adult and done outdoors, due to high release of smoke and gases.

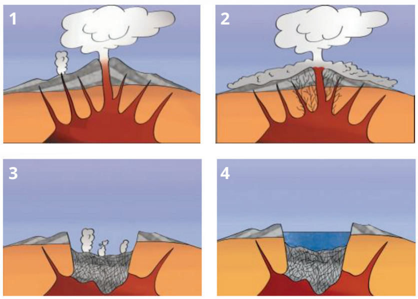
1. Put the ammonium bichromate, sugar, magnesium tape and match heads inside the cylinder can;
2. You can create a volcano structure with sand around the cylinder can to mimic a volcano;
3. Carefully ignite the “volcano” with the long reach match;
4. Now take a step back from your volcano and watch the explosive eruption you've created!

CREATE A VOLCANIC CALDERA (U1)

Calderas are a common structure in volcanic islands such as the Azores. They are created when polygenitc volcanoes collapse due to a fast emptying of the magmatic chamber as a consequence of explosive eruptions. This experiment will allow students to recreate this phenomenon and observe the collapse of the volcano in front of their eyes.

You will need:

- Cardboard box (shoe box or bigger)
- Flour
- Ballon
- Scissor
- Plastic tube with around 10 cm
- Bicycle air pump (optional)
- Duct tape



Make your own Volcanic Caldera!

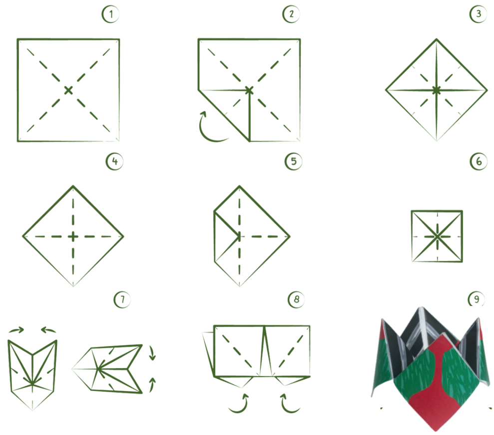
1. Make a small cut, with the scissor, on the inferior part of one of the side walls of the cardboard box;
2. Insert one of the ends of the tube inside the balloon, and fix it tight with duct tape;
3. Pass the balloon through the small cut in the box, leaving the free tube end outside of the box;
4. Fill the box with flour, till half capacity. Make sure the balloon is fully covered;
5. Insert the air pump (or blow) into the tube end outside of the box, to start pumping air. While you do this, observe the deformation of your "crust" as the volcano grows – radial fractures occur.
6. Release the air from the balloon all at once and observe the collapse of your volcano – the result is a CALDERA.

VOLCANO ORIGAMI (U1)

This "volcanic origami" is a rough representation of a volcanic cone that will allow students to play and test their knowledge on this thematics.

You will need:

- Printer
- 1 A4 paper
- Scissor



LET'S CREATE THE VOLCANO ORIGAMI!

1. Cut out the Volcano Origami square.
2. With the white part facing up, fold each corner to the opposite corner (1)
3. Fold all the corners to the center of the paper (2 and 3)
4. Turn the paper upside down (4)
5. Repeat the procedure, folding each corner to the center of the paper (5 and 6)
6. Fold in half horizontally and vertically (7)
7. Insert your fingers into the flaps (8 and 9)
8. Now notice that you've just created a small paper volcano!

What's the name of the reservoir where the magma is stored underneath the surface?

MAGMA CHAMBER

What's the name of the tube where the magma ascends to the surface?

VOLCANIC VENT

What's the science inside geology that studies the volcanoes?

VOLCANOLOGY (GEOLOGY FIELD)

What's the main material expelled during a volcanic eruption?

LAVA

What's the name of the materials formed from the volcanic explosions?

PYROCLASTS

What's it called the volcanic activity in the marine depths?

UNDERWATER VOLCANIC ACTIVITY

What's the name of the volcanoes that are formed from a single eruption?

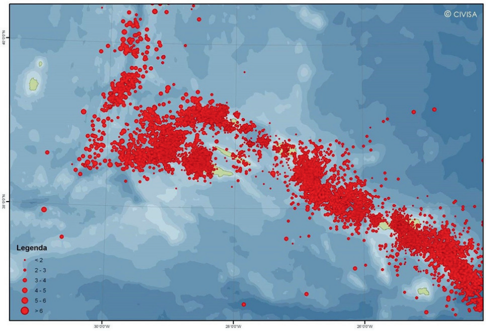
MONOGENETIC VOLCANOES

What's the name of the volcanism occurring along fissures/fractures?

FISSURAL VOLCANISM

WHY DOES THE EARTH SHAKE? (U1)

The Earth's crust is fractured in what we denominate as the **TECTONIC PLATES** (or lithospheric plates).



Seismicity in the Azores in the last 30 years

The boundaries between these plates have different contexts, either they are subjected to compressive, distensile or conservative forces.

Scientists have proven that more than **80%** of seismic and volcanic activity in our Planet occurs along these boundaries. Earthquakes correspond to a sudden release of energy within the Earths' crust causing its vibration.

The following activity proposes the creation of a "homemade" seismograph, allowing to introduce different concepts associated with recording and measuring earthquakes and different scales used.

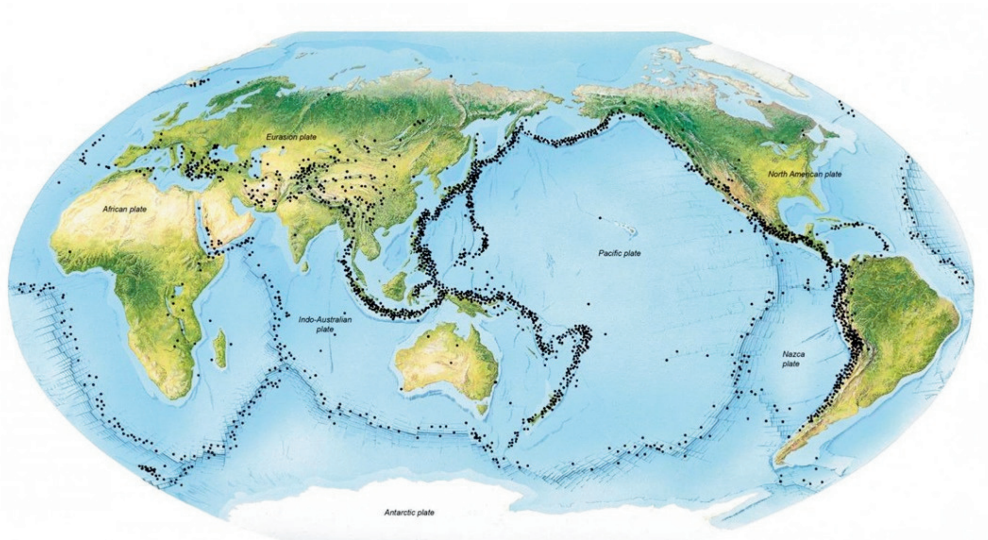
We live in an active planet and we are all agents of civil protection.

You will need:

- Cardboard box (shoe box or bigger)
- Paper cup
- Felt pen
- Scissor
- String
- Duct tape
- Toilet paper or a long paper sheet

Simulate an earthquake and register its magnitude!

1. Carefully make 2 holes in on of the small sides of the box, and pass the string through them;
2. Next make a hole in the middle of the cup's base, to insert the felt pen and use the duct tape to glue the pen to the cup, and to keep it vertical;
3. Make two other holes in the top side of the cup. Pass the string through the cup and box holes to attach it to the box with a double knot. The cup should be hanging with the pen not touching the other side of the box;
4. On both side of the bottom of the box, make small cut with enough space to pass the paper through it;
5. Place the seismograph on a table, and have someone help with shaking the table to simulate and earthquake, ate the same time and the paper is being pulled through the seismograph;
6. The more the table is shaken, the ample the line will be. Play with different intensities of shaking, to have different wave patterns on the seismograph paper.



Bristish Geological Survey

MOLD YOUR FOSSILS (U1)

Fossils are the preserved remains, or traces of remains, of ancient organisms, they are not the remains of the organism itself, they are now **ROCKS**.

A fossil can preserve an entire organism or just part of one - bones, shells, feathers, and leaves can all become fossils.

They can be very large or very small, and they bring to us information on forms of life that no longer exist.

- WINDOWS TO THE PAST -

In this activity is proposed to explore the process that leads to the formation of a mold type fossil.

You will need:

- 1 cup of coffee grounds
- ½ cup of cold liquid coffee
- 1 cup of flour
- ½ cup of coarse salt
- Vegetal paper
- 1 mixing cup
- Clam shells, mussels, limpets or whelks
- Cookie cutter (optional)
- String (optional)
- Toothpick or Kebab stick (optional)
- Painting ink and brush (optional)

LET'S MOLD YOUR FOSSILS!

1. In a bowl mix the coffee ground, the liquid coffee, the flour and the coarse salt till it turns into an even dough;
2. Settle the created dough in a vegetal paper and press it into several small circles. A round cookie cutter can be used too;
3. To make the imprints use the back of the clam shell or other material on the dough circles, applying moderate pressure;
4. Bigger or smaller pieces can be made, such as necklaces, where in can make a small hole in the dough with a toothpick to pass the string;
5. After the molds are made, they can be dried in an oven or under the sun light.
6. After the fossils are made you can use the ink and the brush to paint them in many different ways.

Tree leaf mold in volcanic ashes
Monte Brasil, Terceira island

Fossil deposit "Pedra-que-pica"
Santa Maria island

DEEP TIME (U1 and U5)

Deep time can be difficult to comprehend, and the attempt to communicate it constitutes a challenge for teachers. This is a simple demonstration of the vast length of time that holds important events of the Earth's memory.

How long is 4.6 billion years?

You will need:

- a roll of toilet paper (preferably a roll with 1000 sheets, but any other will work)
- Optional: toys of dinossaurs, printed images, rocks and fossils if they are available

This activity involves using a roll of toilet paper to demonstrate the vast length of time involved in **Deep Time** (or geological time). Important events in geologic history are marked on the toilet paper as it is unrolled in front of the class. Students begin to get a sense of how little time humanity has been on Earth and how much time is really involved.

Unroll your toilet paper as it goes marking specific events like first hominids, first dinosaurs, ediacara fauna, etc. The events marked can be adapted to the territory or to the concepts that are being introduced to the class.

Note

A modifiable Excel* table showing the length from the start of the toilet paper roll (present day) to important events in geologic history.

This file can be modified by changing the values in the first row.

*You can find the excel file in the EMME project's shared folder

This activity is part of the On the Cutting Edge Peer Reviewed Teaching Activities collection. 2006

TABELA CRONOESTRATIGRÁFICA INTERNACIONAL

IUGS www.stratigraphy.org **Comissão Internacional de Estratigrafia** v 2023/04

Eonotema / Éon	Eratema / Era	Sistema / Período	Série / Época	Andar / Idade	Idade (Ma)
					atualidade
Fanerozoico	Cenozoico	Quaternário	Holocénico (S)	Megalayano	0.0042
			Holocénico (M)	Northgrippiano	0.0082
			Holocénico (I)	Greenlandiano	0.0117
			Pleistocénico (S)	*Superior*	0.129
			Pleistocénico (M)	Chibaniano	0.774
			Pleistocénico (I)	Calabriano	1.80
				Gelasiano	2.58
		Neogénico	Pliocénico (S)	Piacenziano	3.600
			Pliocénico (I)	Zancleano	5.333
			Miocénico (S)	Messiniano	7.246
				Tortoniano	11.63
			Miocénico (M)	Serravalliano	13.82
				Langhiano	15.97
			Miocénico (I)	Burdigaliano	20.44
				Aquitaniano	23.03
		Paleogénico	Oligocénico	Chattiano	27.82
				Rupeliano	33.9
			Eocénico	Priaboniano	37.71
				Bartoniano	41.2
				Lutetiano	47.8
				Ypresiano	56.0
			Paleocénico	Thanetiano	59.2
				Selandiano	61.6
				Daniano	66.0
	Mesozoico	Cretácico	Superior	Maastrichtiano	72.1 ±0.2
				Campaniano	83.6 ±0.2
				Santoniano	86.3 ±0.5
				Coniaciano	89.8 ±0.3
				Turoniano	93.9
				Cenomaniano	100.5
			Inferior	Albiano	~ 113.0
				Aptiano	~ 121.4
				Barremiano	125.77
				Hauteriviano	~ 132.6
				Valanginiano	~ 139.8
				Berriasiano	~ 145.0

Eonotema / Éon	Eratema / Era	Sistema / Período	Série / Época	Andar / Idade	Idade (Ma)
					~ 145.0
Fanerozoico	Mesozoico	Jurássico	Superior	Tithoniano	149.2 ±0.7
				Kimmeridgiano	154.8 ±0.8
				Oxfordiano	161.5 ±1.0
			Médio	Calloviano	165.3 ±1.1
				Bathoniano	168.2 ±1.2
				Bajociano	170.9 ±0.8
				Aaleniano	174.7 ±0.8
			Inferior	Toarciano	184.2 ±0.3
				Pliensbachiano	192.9 ±0.3
				Sinemuriano	199.5 ±0.3
				Hettangiano	201.4 ±0.2
		Triássico	Superior	Rhaetiano	~ 208.5
				Noriano	~ 227
				Carniano	~ 237
			Médio	Ladiniano	~ 242
				Anisiano	247.2
			Inferior	Olenekiano	251.2
				Induano	251.902 ±0.024
	Paleozoico	Pérmico	Lopingiano	Changhsingiano	254.14 ±0.07
				Wuchiapingiano	259.51 ±0.21
			Guadalupiano	Capitaniano	264.28 ±0.16
				Wordiano	266.9 ±0.4
				Roadiano	273.01 ±0.14
			Cisuraliano	Kunguriano	283.5 ±0.6
				Artinskiano	290.1 ±0.26
				Sakmariano	293.52 ±0.17
				Asseliano	298.9 ±0.15
		Carbónico – Pennsylvánico	Superior	Gzheliano	303.7 ±0.1
				Kasimoviano	307.0 ±0.1
			Médio	Moscoviano	315.2 ±0.2
			Inferior	Bashkiriano	323.2 ±0.4
		Carbónico – Mississíppico	Superior	Serpukhoviano	330.9 ±0.2
			Médio	Viseano	346.7 ±0.4
			Inferior	Tournaisiano	358.9 ±0.4

Eonotema / Éon	Eratema / Era	Sistema / Período	Série / Época	Andar / Idade	Idade (Ma)
					358.9 ±0.4
Fanerozoico	Paleozoico	Devónico	Superior	Famenniano	372.2 ±1.6
				Frasniano	382.7 ±1.6
			Médio	Givetiano	387.7 ±0.8
				Eifeliano	393.3 ±1.2
			Inferior	Emsiano	407.6 ±2.6
				Pragiano	410.8 ±2.8
				Lochkoviano	419.2 ±3.2
		Silúrico	Pridoli		423.0 ±2.3
			Ludlow	Ludfordiano	425.6 ±0.9
				Gorstiano	427.4 ±0.5
			Wenlock	Homeriano	430.5 ±0.7
				Sheinwoodiano	433.4 ±0.8
			Llandovery	Telychiano	438.5 ±1.1
				Aeroniano	440.8 ±1.2
				Rhuddaniano	443.8 ±1.5
		Ordovícico	Superior	Hirnantiano	445.2 ±1.4
				Katiano	453.0 ±0.7
				Sandbiano	458.4 ±0.9
			Médio	Darriwiliano	467.3 ±1.1
				Dapingiano	470.0 ±1.4
			Inferior	Floiano	477.7 ±1.4
				Tremadociano	485.4 ±1.9
		Câmbrico	Furongiano	*Andar 10*	~ 489.5
				Jiangshaniano	~ 494
				Paibiano	~ 497
			Miaolingiano	Guzhangiano	~ 500.5
				Drumiano	~ 504.5
				Wuliuano	~ 509
			Série 2	*Andar 4*	~ 514
				Andar 3	~ 521
			Terreneuviano	*Andar 2*	~ 529
				Fortuniano	538.8 ±0.2

Eonotema / Éon	Eratema / Era	Sistema / Período	Idade (Ma)
			538.8 ±0.2
Precâmbrico – Proterozoico	Neoproterozoico	Ediacárico	~ 635
		Cryogénico	~ 720
		Tónico	1000
	Mesoproterozoico	Sténico	1200
		Ectásico	1400
		Calymmico	1600
	Paleoproterozoico	Stathérico	1800
		Orosírico	2050
		Rhyácico	2300
		Sidérico	2500
Precâmbrico – Arcaico	Neoarcaico		2800
	Mesoarcaico		3200
	Paleoarcaico		3600
	Eoarcaico		4000
Precâmbrico – Hádico			4567

A definição do Estratotipo Global de Limite (GSSP - Global Boundary Stratotype Section and Point) para a base dos diversos andares, séries, sistemas e eratemas, é um processo ainda incompleto. O mesmo ocorre com os estratotipos de limite das unidades do Arcaico e Proterozoico, cuja divisão inicial é fundamentada numa convenção de idades absolutas (GSSA - Global Standard Stratigraphic Ages). Os GSSP oficiais estão assinalados com o símbolo do "Prego Dourado" (Golden Spike), que também os materializa no terreno.

A Tabela original e os detalhes sobre os GSSP (critério de definição de cada um, localização geográfica e geológica, correlação, etc.), atualizam-se regularmente na web page: http://www.stratigraphy.org.

As Subséries e Subépocas ratificadas estão abreviadas como S (Superior), M (Médio) e I (Inferior). A datação absoluta em milhões de anos (Ma) para a base do Ediacárico e das restantes unidades do Fanerozoico é apenas orientadora, em especial para os limites sem GSSP formal (~Ma). Estes valores poderão ser revistos no futuro ou serem recalibrados geocronometricamente. Os valores indicados são provenientes de Gradstein *et al.* (*A Geologic Time Scale 2012*), excetuando as datações do Quaternário, Paleogénico Superior, Cretácico, Jurássico, Triássico, Pérmico, Câmbrico e Precâmbrico, fornecidas pelas subcomissões respetivas da ICS-IUGS.

Tabela desenhada por K.M. Cohen, D.A.T. Harper, P.L. Gibbard e N. Car
Abril de 2023 © International Commission on Stratigraphy (IUGS)

Citar: Cohen, K.M., Finney, S.C., Gibbard, P.L. & Fan, J.-X. (2013; atualizada) The ICS International chronostratigraphic Chart. Episodes 36: 199-204.

http://www.stratigraphy.org/ICSchart/ChronostratChart2023-04PTPortuguese.pdf

As cores padrão são as adotadas pela Comissão do Mapa Geológico do Mundo (CCGM-IUGS) – http://www.ccgm.org

Tradução para Português (PT) efetuada por A.A. Sá, C. Meireles, Z. Pereira, M.H. Henriques, e J.M. Piçarra, em colaboração com o Comité Português para o Programa Internacional de Geociências (IGCP/UNESCO) e o Laboratório Nacional de Energia e Geologia, I.P.

GEOSITES AND GEODIVERSITY ROUTES (GEO) PRODUCTS ROUTES (GEO) URBAN ROUTES (U1, U2, U3 and U4)

Thematic routes can be multidisciplinary tools for understanding the different aspects associated with the natural and cultural identity of the territory.

Geosites and Geodiversity Routes

should be representative of the geodiversity of the territory and provide the opportunity to observe *in loco* the memory of the Earth (landscapes that tell us their history), associated biodiversity and human activity. This kind of route allows a holistic approach to the territory.

(GEO) Products Routes

are an opportunity to promote partners that implement sustainable practices in their production - agricultural or products transformation like cheese production. It is also an opportunity to establish a conection between our food and our territory - natural and/or cultural aspects.

(GEO) Urban Routes

are an easy access resource for neighboring schools to interpret built heritage and make a connection with natural resources and geology around the area.

A story of how local communities have used geological resources to built urban areas and how these connect with cultural and historical aspects of the region.

Example of the leaflet of (GEO) Urban Route of Angra do Heroísmo

NOTES