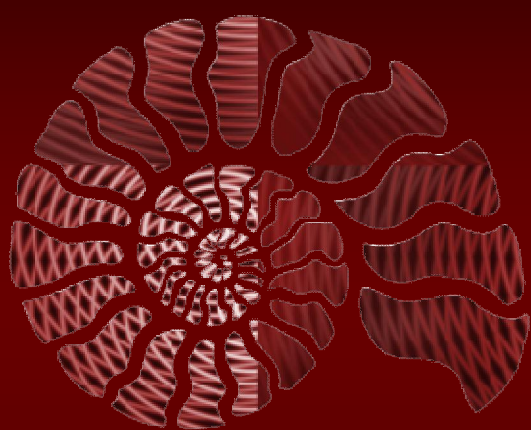


GEOschools

GEOSCIENCES TEACHING in Portugal



**GEO
SCHOOLS**

EN

2011



Portugal curriculum report

Geosciences teaching in Portugal

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The Portuguese educational system is divided in 5 main stages: pre primary school (5-6 years old: a preparation to the school), 1st cycle (6-10 years old: primary school), 2nd cycle (10-12 years old), 3rd cycle (12-15) and secondary school (15-18 years old: high school).

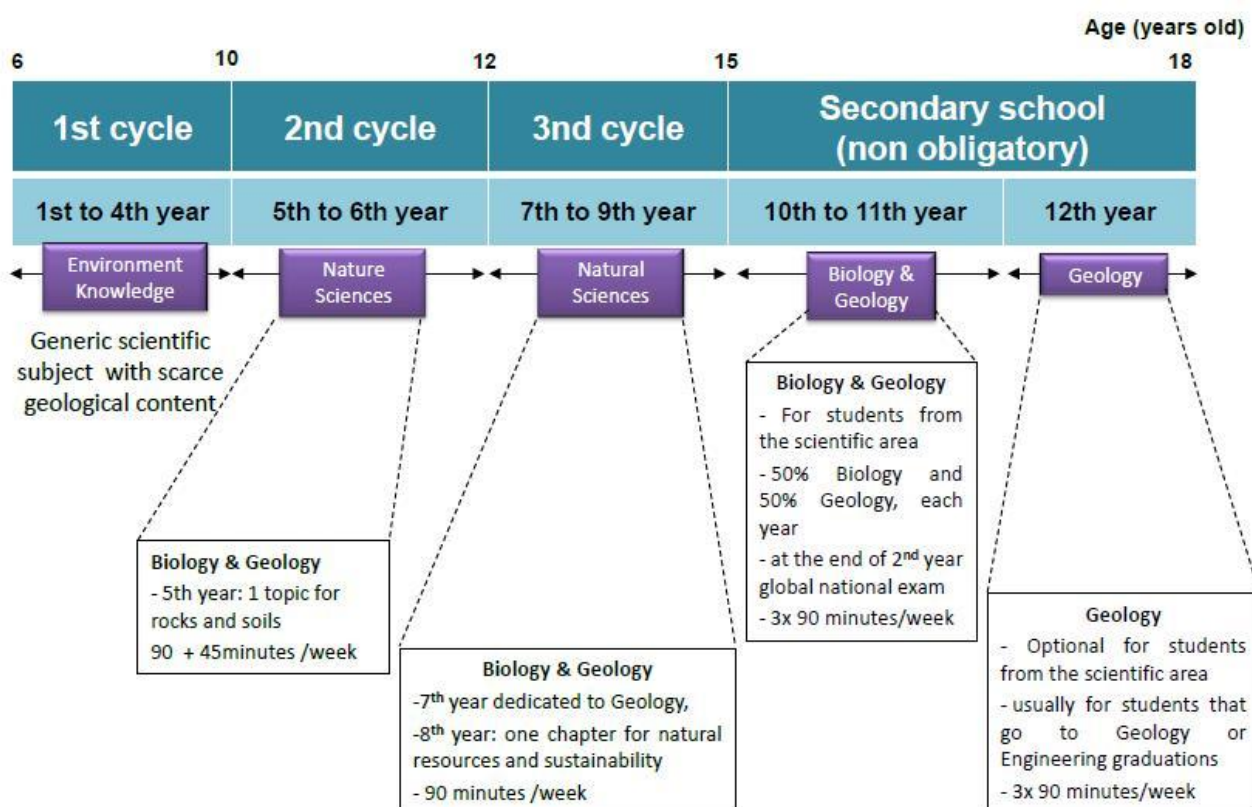


Table I: Portuguese educational system

1st cycle

During 1st cycle Geosciences topics are disseminated in the subject Environment Knowledge. During the 4 years students learn generic scientific subjects with scarce geological content: rock characteristics and use, relief forms, groundwater's and springs and mineral resources exploitation. Each class has one single teacher who teaches all the matters (Portuguese, Math and Environment Knowledge), graduated in Basic Education.

2nd cycle

The *2nd cycle* is the stage with less Geosciences topics with only a very light topic, in the 5th grade, about rocks (rock weathering and soil formation).

In this cycle Nature Sciences teachers also teach Math and elder teachers can have several graduations such as Engineering, Agronomy, Pharmacy, Biology, Mathematics, Management, etc. Younger teachers are graduated in Nature Sciences and Mathematics, by the Educational Superior School.

3rd cycle

The *3rd cycle* is the last obligatory stage. Geosciences are included in Natural Sciences (Geology and Biology). The 7th grade is almost 90% dedicated to Geology. Usually, Portuguese classes have more or less 30 pupils and in some matters, such as Physics and Chemistry and Biology and Geology, classes are divided in 2 smaller groups to promote practical activities.

Natural Sciences (7 th grade)	
Concepts	Skills
<p>THE EARTH ON SPACE Earth – A planet with life - Earth's conditions which allow the existence of life - The Earth as a system Science, Technology, Society and Environment - Science as a human activity product - Science and knowledge of the Universe</p>	<ul style="list-style-type: none"> - Pondering about Earth conditions which make it the only planet with life - Visualizing documentaries with living beings in their natural environments - Observing microorganisms, animal and vegetal cells - Raising awareness to the importance of the interactions between Science, Technology and Environment - Sensitizing for the dynamic character of science
<p>THE EARTH IN TRANSFORMATION The Earth tells its history - Fossils and their importance for the reconstitution of the Earth's history - Major stages on the Earth's history Inner Dynamic Earth - Continental drift and plate tectonics - Occurrence of faults and folds Consequences of the Earth's Inner Dynamic - Volcanic activity; risks and benefits of the volcanic activity - Seismic activity; risks and protection of the populations Earth's inner structure - Contribution of science and technology to the study of the Earth's inner structure - Proposing models Earth's External Dynamic - Rocks, testimony of the Earth's activity - Magmatic, sedimentary and metamorphic rocks: genesis and constitution of the Rocks' cycle. - Geological landscapes</p>	<ul style="list-style-type: none"> - Understanding the benefits provided by the scientific and technological development for humankind, which simultaneously put people and the environment at risk - Performing practical activities: field trips to observe and collect fossils, visiting museums, building external and internal mold casts - Observing and debating about images related to the large steps of the Earth's History - Debating Wegener's hypothesis - Simulating the Theory of Plate Tectonics - Understanding Earth's dynamics - Building models of faults and folds - Building models of volcanoes and observing what happens during the simulation of an eruption - Exploring and debating maps of isosseisical lines and seismograms - Building simplified models of the Earth's inner structure - Observing rocks and minerals' hand specimens - Understanding the differences between a granite and a basalt and sedimentary and metamorphic rocks - Doing a field trip to observe the rocks and the geological landscapes

Table II: Geosciences in "Natural Sciences" contents and skills for the 7th grade

In the 7th grade there are some Geosciences topics in the matter Geography (90 minutes /week). Themes “Relief” and “Risks and Disasters” take 2/5 of the annual program.

<i>Geography (7th grade)</i>	
Concepts	Skills
<p><i>Relief</i></p> <ul style="list-style-type: none"> - Major reliefs (mountains, plains, plateaus, hills), - Dynamics of a watershed (drainage basins, landscape modeling), - Coastal dynamics (beaches, cliffs, cliffs retreat, coastal evolution) 	<ul style="list-style-type: none"> - Promote the curiosity to discover and experience diverse landscape and territories, valuing their diversity as a natural and cultural wealth that we must preserve from threats caused by human intervention in the environment and favorable disposition for their conservation and protection.
<p><i>Risks and Disasters</i></p> <ul style="list-style-type: none"> - Causes for natural disasters (floods, droughts, storms, earthquakes, volcanoes) - Effects on humans and the environment 	

Table III: Geosciences in “Geography” contents and skills for the 7th grade

National curricula foster interdisciplinary approaches, between Geography and Natural Sciences.

The 8th grade includes just a very small topic, which comes after the study of the unit “Ecosystems”

<i>Natural Sciences (8th grade)</i>	
Concepts	Skills
<i>Sustainable Management of Resources</i>	
<p><i>Natural resources – uses and consequences</i></p> <ul style="list-style-type: none"> - Mineral resources - Energy resources 	<ul style="list-style-type: none"> - Understand the importance of natural resources, for human society development - Discuss the consequences for the planet from natural resources non sustainable use - Know different strategies to protect environment - Know Protected Areas - Recognize alternatives to maintain Earth planet sustainability
<p><i>Nature protection and conservation</i></p>	

Table IV: Geosciences in “Natural Sciences” contents and skills for the 8th grade

The 9th grade (last of obligatory school) doesn't have geosciences topics.

Natural Sciences teachers from the 3rd cycle are also teachers at the high school and teach Biology and Geology, Environmental Sciences, Health, Human Biology. Elder teachers are mostly graduated in Biology (most of them) and Geology and younger teachers in Biology and Geology (for education). These graduations belong to the Sciences Faculties.

High school

The *high school* (secondary school = Portuguese) begins at the 10th grade and students have to choose which knowledge area they want to study, depending on what they want to do in the future (for example: Sciences/Technologies, Arts, Literature & Humanities and Economy).

Students that choose sciences & technologies are obliged to study Geosciences, included in Biology and Geology, (exactly 50% for each) and most of the topics were already introduced in the 7th grade. There are 3 classes/week (90 minutes each), one with the class divided in two groups for practical activities. The course takes 2 years and at the end there is a national exam for all the students.

<i>Biology and Geology</i>	
<i>10th grade</i>	<i>11th grade</i>
<p>I - Geology, geologists and their methods</p> <p>1. <i>Earth and its subsystems interacting</i> (geosphere, biosphere, atmosphere and hydrosphere)</p> <p>2. <i>Rocks, Earth History archives</i></p> <p>2.1 Sedimentary rocks</p> <p>2.2 Magmatic and metamorphic rocks</p> <p>2.3 Rock cycle</p> <p>3. <i>Measuring time and Earth age</i></p> <p>3.1 Relative and radiometric age</p> <p>3.2 Geological time memory</p> <p>4. <i>The Earth, a changing planet.</i></p> <p>4.1 Basic principles of Geology</p> <p>4.2. Tectonic plates and their movement</p>	<p>IV - Geology, quotidian problems and materials</p> <p>1. <i>Human occupation and land management problems:</i></p> <p>1.1 Drainage basin</p> <p>1.2 Coastal areas</p> <p>1.3 Slope areas</p> <p>2. <i>Geological processes and materials important to terrestrial environments.</i></p> <p>2.1 Main stages of formation of sedimentary rock. Sedimentary rocks. Sedimentary rocks: Earth historical archives.</p> <p>2.2 Magmatic processes. Magmatic rocks.</p> <p>2.3 Fragile and ductile deformation. Faults and folds.</p> <p>2.4 Metamorphism. Metamorphism agents. Metamorphic rocks.</p> <p>3. <i>Sustainable exploitation of geological resources.</i></p>
<p>II – Earth, a very special planet</p> <p>1. <i>Solar system formation</i></p> <p>2. <i>Earth and terrestrial planets</i> (evidences of geological dynamics)</p> <p>3. <i>Earth, a unique planet to protect</i></p> <p>3.1 Continents and seafloor</p> <p>3.2 Man and Earth subsystems (impacts, environmental protection, sustainable development)</p>	
<p>III - Understanding geosphere structure and dynamics</p> <p>1. <i>Methods for study geosphere interior</i></p> <p>2. <i>Vulcanology</i></p> <p>2.1 Basic concepts</p>	

2.2 Volcanoes and tectonic plates
2.3 Minimization of volcanic hazards: prediction and prevention.
<i>3. Seismology</i>
2.1 Basic concepts
2.2 Earthquakes and tectonic plates
2.3 Minimization of seismic risks: prediction and prevention
3.4 Seismic waves and internal discontinuities
<i>4. Internal structure of the geosphere</i>
4.1 Model by chemical composition
4.2 Model by physical properties

Table V: Geosciences in "Biology and Geology" contents for 10th and 11th grades

In 12th grade there is a matter called Geology, optional, even for the students from the scientific area. Some contents were already studied in the 7th, 10th and 11th grade.

<i>Geology (12th grade)</i>
<p>I – From the Continental Drift Theory to the Plate Tectonics Theory. Lithosphere dynamics.</p> <p><i>1. Genesis and evolution of the Continental Drift Theory.</i></p> <p>1.1. The terrestrial globe explained by the contraction defenders and the permanentists?? (pre-wegenerian period).</p> <p>1.2. The Continental Drift Theory by Wegener. Geophysical, Geological, Paleontological, Paleoclimatical and Geodesical arguments.</p> <p>1.3. Criticism of the Continental Drift Theory.</p> <p>1.4. The first steps for a new theory – the Theory of Plate Tectonics. Topography of the seafloor and paleomagnetic evidences.</p> <p><i>2. Lithosphere dynamics and geological big structures.</i></p> <p>2.1. The convection of the terrestrial mantle and the movement of the lithospheric plates.</p> <p>2.2. Vertical movements of the lithosphere. Isostatic balance.</p> <p>2.3. Horizontal movements of the lithosphere. Formation of Rifts and mountains</p>
<p>II – The history of Earth and Life</p> <p><i>1. The measure of time and the History of Earth. Examples of dating methods.</i></p> <p>1.1. Sedimentary "Clocks". Lithostratigraphy. Freeze-thaw cycles.</p> <p>1.2. "Paleontological clocks". Biostratigraphy. Dendrochronology.</p> <p>1.3. Physical and geophysical methods. Radiometric dating. Magnetostratigraphy.</p> <p><i>2. Chronostratigraphical Table. Equivalence between chronostratigraphical and geochronological units.</i></p> <p><i>3. Geohistory. Life in Pre-Cambrian, Paleozoic, Mesozoic and Cenozoic. Paleogeographic evolution.</i></p> <p><i>4. The geological history of a region.</i></p> <p>4.1. Geological mapping.</p>

4.2. Interpretation of the main geological aspects of the region where the school is located by using a map

III – The Earth yesterday, today and tomorrow

1. *The Earth before the appearance of the human being. Paleoclimate and impact of lithospheric dynamics on climate changes.*

2. *Environmental changes on Earth's History and evolution of the human being.*

3. *The human being as an agent of environmental changes.*

3.1. Global warming.

3.2. Exploration of minerals and materials of construction and ornamentals. Contamination of the environment.

3.3. Exploitation and changing of soils.

3.4. Exploitation and contamination of waters.

4. *What to expect in the 21st. century? Regional and global environmental changes.*

Table V: "Geology" contents for the 12th grade

Final remarks:

- For each grade there are several textbooks from different publishers and each school chooses the book for 3/4 years.
- The obligatory school will be enlarged until 12th grade (18 years) in few years?
- The curricula and textbooks suggest fieldtrips (with information for teachers and students)



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