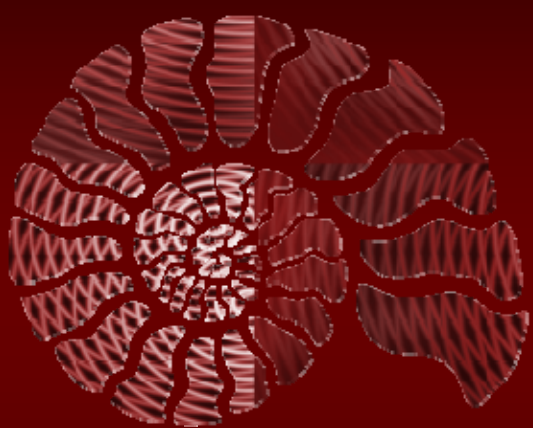


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GEOSCIENCES TEACHING in Spain



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2011



Teaching Geology in Spain

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Introduction

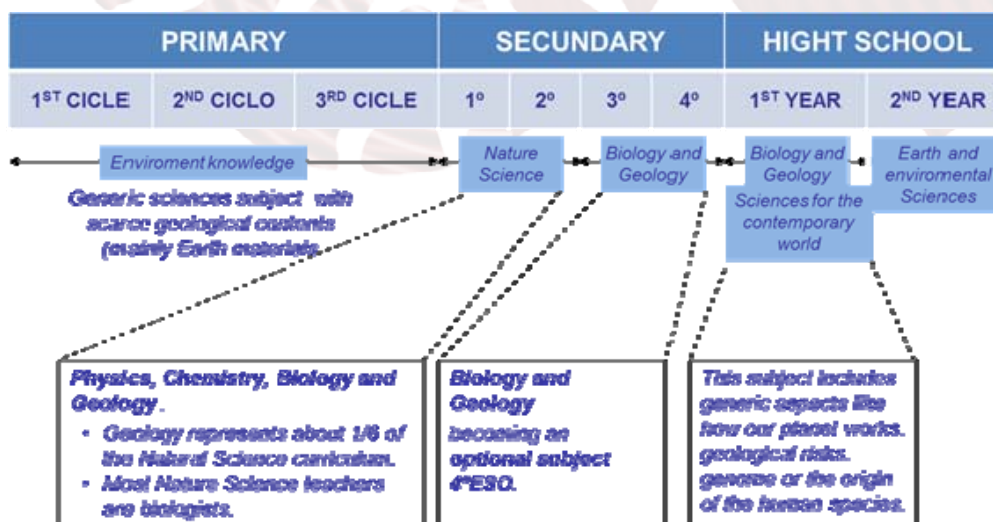
The Constitutional Kingdom of Spain is located in the South-Western corner of Europe, sharing the Iberian Peninsula with Portugal. Since democracy was established in the seventies, our country has developed a strongly decentralized structure, with 17 Regional Governments (more or less equivalent to the German “lander” or to the different “states” in the U.S.A.).

These “autonomous communities” have their own parliament and government with different departments, including the Department of Education. Following the wide guidelines dictated by law by the National Ministry of Education, every Autonomous Government has full authority upon the organisation of educational curricula for non-university education.

Another particularity of our educational system is the coexistence of Spanish with three other official languages being spoken in three specific parts of the country. These languages (Catalan, Basque and Galician) are the teaching languages (in some case, exclusively) within those territories.

On the other hand Earth Sciences’ relevance has been increasing throughout the last decades. Thus, we need to know better how the Earth works, how crucial is the economic interest of natural resources (industrial rocks, fossil fuels or underground water), how will: climate change, geological risks, desertification, natural resources management, etc., affect our society, economy and environment. These questions can’t be answered without the theoretical and procedural body knowledge provided by Earth Sciences. We, therefore, state that only educated citizens will be prepared to understand and value them and act accordingly with an appropriate sensibility and responsibility.

Geology teaching in Spain



Education in Spain is compulsory for all pupils under 16. Education is comprehensive at these ages (pupils with different abilities share the classroom)¹. These studies are organised in three stages as showed in the table below:

¹ A law approved by the former National Government established “itineraries” (different curricula according to their marks) for the pupils in the fourth course (scientific, humanistic, technological). Elections in March 2004 changed the government and this law (Law for the Quality of Education) is now suspended.

Thus, in Primary School (6 to 12 years old) students attend a general Science subject called “Conocimiento del medio” (“Environment knowledge”) with scarce geological contents (mainly Earth materials). In Compulsory Secondary School, or ESO, (12 to 16 years) the same thread is deepened and a single Science subject is taught (“Nature Science” in the first two years), with few geological contents that help to explain the key factors affecting the processes that happen in our planet. In the last two years of this cycle the subject “Biology and Geology” is separated from the other sciences becoming an optional subject in the last year; thus, it will be attended only by part of the pupils that will learn about Plate Tectonics and the Biological Evolution theories, put together with relevant issues such as Genetics or Earth and Life history.

Once the Compulsory Secondary Education (ESO) is finished, pupils have four different ways to follow:

- For those who didn’t succeed, the options are:
 - Start working
 - Follow a Lower Level Vocational Course
- Those with good marks can choose between:
 - Following a Medium Level Vocational Course
 - Studying “Bachillerato”, the formal two-years course (16-18) leading to University as well as High Level Vocational Courses

As a rule, all Spanish Secondary schools teach ESO and Bachillerato; many of them offer Medium and High Level vocational courses, as well.

Earth Science in Compulsory Secondary Education (ESO)

As you can see above, Compulsory Secondary School, or ESO, is divided in two cycles: 1st cycle (12-14) and 2nd cycle (14-16). The subject usually called “Science” in most countries is called “Natural Science” in our country and includes contents ranging from: Physics, Chemistry, Biology and Geology or Earth Science (there’s a strong internal controversy about the name we should use for our subject). In fact, if we examine the curriculum for Biology and Geology (which represents about half of the Natural Science curriculum), we can see that only about a third of it is Geology (table I). Another remarkable aspect is the fact that most teachers of Biology and Geology are biologists, being geologists a small minority (Table II).

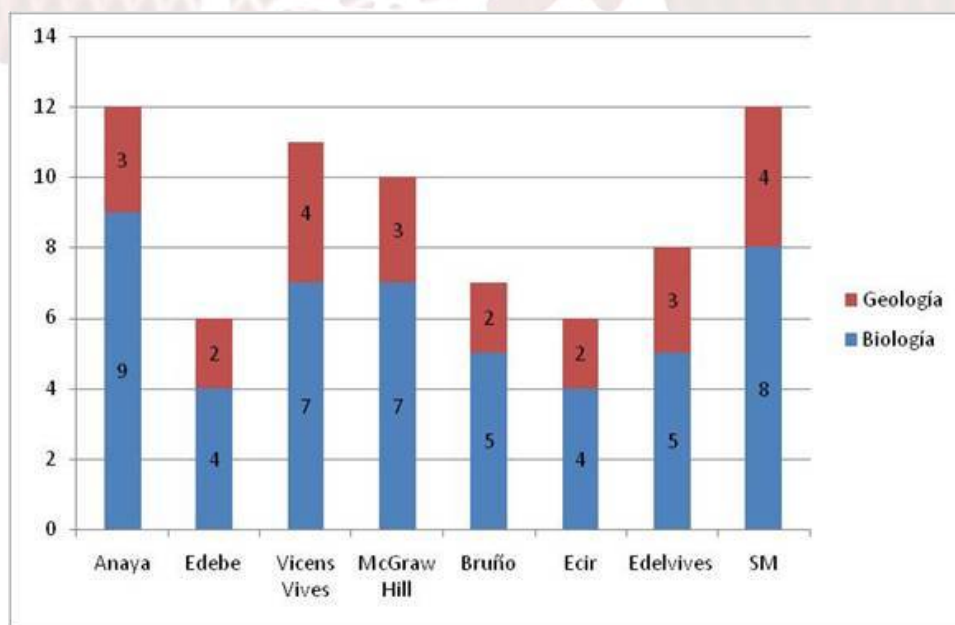


Table I. Projection of quantitative data regarding the occurrence and treatment of Geology topics in relation to the total number of items in the textbooks analyzed in the second cycle (ESO).

Usually, during the first two courses, pupils are taught what we call “integrated science”: the four science subjects are taught by the same teacher spread along the syllabus of the two courses of this 1st cycle.

Some of the contents usually considered belonging to Earth Science can be found spread in the curricula of a wide range of subjects: astronomy, physical geography, plate tectonics in Social Science; maps and scales in Physical Education; materials and sources of energy in Technology, and so on.

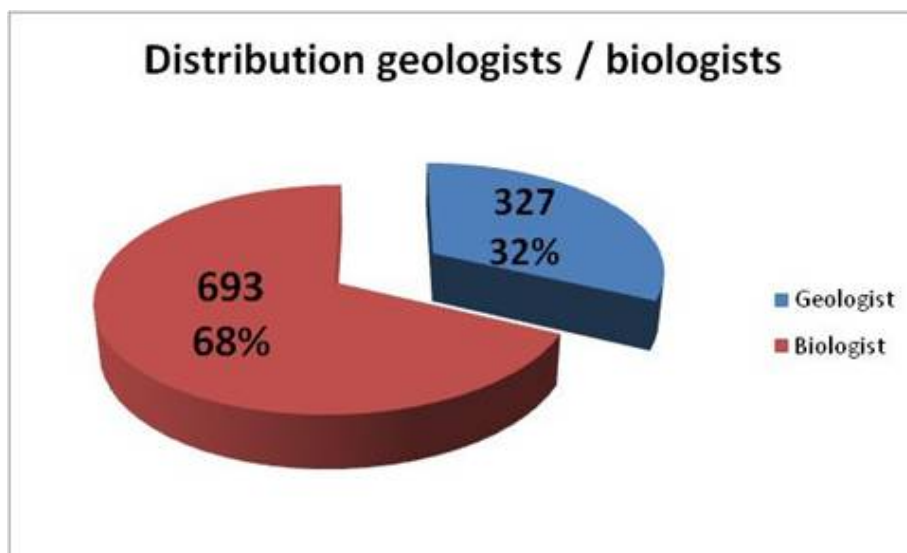


Table II. Quantitative ratio between biologists and geologists in ESO.

The number of sessions of 60 minutes vary from one community to another with an average of 3 to 4 sessions per week. Some communities divide the class in two halves for practical activities.

A summarized average curriculum for 1st cycle with three hours per week may be as follows:

- *Earth in the Universe and the Solar System.*
- *Earth materials.*
- *The atmosphere.*
- *Hydrosphere.*
- *Geosphere.*
- *Geological changes due to the internal energy of the Earth.*
- *Energy transfer within the Earth.*

In the third year of ESO there is a single subject about “*Biology and Geology*” with two hours per week. The students will study the following topics:

- *Geological external processes.*
- *Geological activity outside of planet Earth.*

Finally, in the last year (16 years) there is an optional subject. The contents are:

- *Origin and evolution of Life.*
- *The landscape.*
- *The interior of the Earth.*
- *Plate Tectonics.*
- *Plate Tectonics’ proofs.*
- *The history of the Earth.*

Unfortunately, you can see that Plate Tectonics is being studied for the first time at that age and in an optional subject.

Of course, in the curriculum there are not only conceptual contents but also skills and personal attitudes’ contents which are not considered in this article.

Earth Science in Post-16 (Pre-University) Education

Earth Science as an optional subject is usually taught in one of the “Bachilleratos” (High School): Scientific, Bio-Sanitary or Scientific-Technological one (using different names in the different autonomous communities), the others being: Humanistic, Linguistic, Artistic, etc.

This stage is divided in two courses: 1st and 2nd of “Bachillerato”

Two different general models can be found across the different Autonomous Communities.

The model proposed by the National Ministry of Education, and adopted by most of the Autonomous Communities, can be

summarized as follows:

1 ST COURSE	2 ND COURSE
Biology/Geology (4 sessions per week)	Earth and Environmental Science (4 sessions per week)

Geology subjects in this level are all of them optional. In the first course half of the subject Biology/Geology is devoted to what we can consider the classical themes of Geology: origin and structure of the Earth, Earth dynamics (internal and external processes), minerals and rocks, history of the Earth...

The subject Earth and Environmental Science (about 20% geological contents) introduces a holistic approach to the Earth considered as a system of subsystems (Atmosphere, Hydrosphere, etc.). The study of the Biosphere (ecosystems) is included in this subject.

However, we may congratulate ourselves as in the first course (17 years) a new subject called "*Ciencias para el Mundo Contemporáneo*" ("*Sciences for the contemporary world*") is part of the curriculum for all students including about 15% of geological contents. This subject started last year and its aim is facing the lack of interest in Sciences. It includes aspects like: how our planet works, geological risks, genome or the origin of the human species. Regarding Geology the contents are the following:

1. *Common contents*: introduce the students to the scientific Method: problem identification, looking for information, drafting a report, etc.
2. *Our place in the Universe*: includes subjects related to our origin ranging from the formation of the Universe and the Earth, up to the origin of the human species, and through the beginning of Life.
3. *Live more, live better*: deals with illnesses, medicines, new trends in medicine, etc., and the relationships between Earth Sciences and the Health Sciences.
4. *Achieving a sustainable management of the planet*: includes climate change and natural risks like earthquakes, volcanic eruptions, tsunamis, floods, land sliding, etc.
5. *New needs, new materials*: modern society has increasing needs of: water, minerals, rocks and fossil fuels, resources that are not renewable.
6. *Global village: From the information society to the knowledge society*: Earth Sciences, or Geology, not only tries to explain the Earth's past (Lyell used to say "the present is the key for the past") but to help in the forecast and management of a sustainable future.

Earth Science contents in Post-16 (Pre-University) Education

In this section we will describe and analyse the contents taught in Earth and Environmental Science paying attention not only to the concepts, but also to skills and personal attitudes of pupils. This approach should be useful to design the 1st International Earth Science Olympiad.

As it has been said before, this subject is devoted to the study of the Earth as a system following the systems theory, analysing its entries and outcomes of matter and energy as well as the complex network of processes and relationships established among its different components.

Although different approaches are possible, most text books analyse the different subsystems of the Earth (atmosphere, hydrosphere, etc.) paying attention not only to its natural or normal behaviour, but also to the resources we get from them, as well as the risks and impacts we introduce in them, and the different options available to manage them (especially under the perspective of sustainable development).

Concepts

The basic principles that determine the concepts studied in this subject are:

- A holistic approach,
- The Earth considered as a system of systems,
- And for every subsystem of the Earth, the study of:
 - Resources,
 - Impacts,
 - Risks,

- Management.

A summary of the concepts could be as follows:

- Introduction. Theory of systems
- Earth materials: minerals and rocks
- Internal processes (geosphere)
- The atmosphere
- The hydrosphere
- External processes (geosphere)
- Pedosphere (soils)
- Natural resources
- Natural risks
- Impacts on the environment

Every Autonomous Community can emphasize any environmental issue that is important in that region; for instance: volcanic risk in Canary Islands; water resources management in Andalusia; flooding risks in Catalonia, etc.)

Skills

At the end of this course, pupils should be able to:

- Use maps, compass and GPS
- Identify minerals, rocks and structures
- Collect geological samples and information from different sources
- Use different lab techniques
- Work with different kinds of text, tables and graphs
- Work with geological maps, stratigraphical columns, block-diagrams, etc.
- Map and analyse resources, risks and impacts
- Write environmental reports

This means that practical activities should be an important part of the subject and that pupils should become familiar with graphs, maps and other representation methods as well as with diverse lab material (including data logging sensors).

Personal attitudes

Under the perspective of a sustainable development, Earth Science should be a tool to increase pupils' environmental awareness and consciousness.

The Earth and Environmental Science curriculum in Spain considers the following aspects about pupils' personal attitudes:

- Conscience and awareness of how environmental factors affect our life
- Awareness of personal responsibility about environment preservation
- Reflexion about consumption habits
- Assessment of how human activities influence resources, risks and impacts
- Awareness of how different the situation can be for different countries regarding resources exploitation and life standards
- Respectful behaviour during the field trips

Final considerations

As a summary of what has been said previously we could state the following:

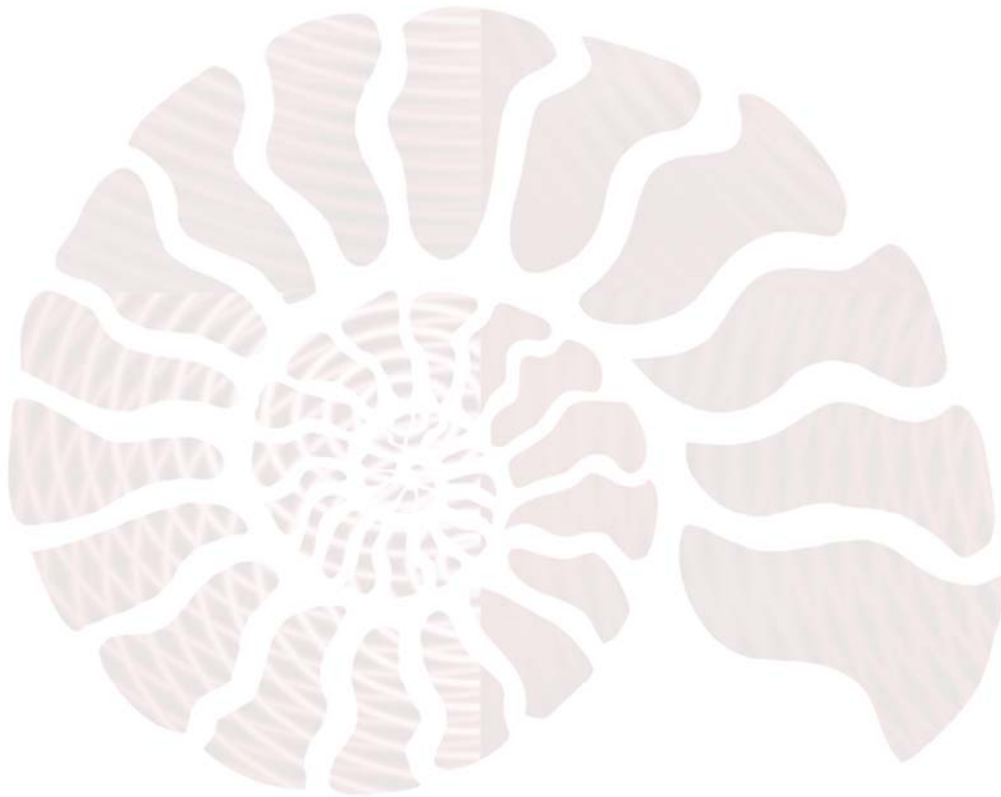
- In Spain, and as a difference from most countries of Western Europe, in Secondary Education, there are specific subjects with the words "Geology" or "Earth Science" in its name. (For instance, in the United Kingdom all these contents are spread among the subjects called Biology, Physics and Chemistry.).
- Most Earth Science teachers involved in teaching these subjects are biologists. Teacher training courses for these teachers are strictly necessary and some institutions (especially AEPECT) organise them. The most popular are: Fossils world, Mapping courses, Practical Geology and Geology field trips.
- Earth Sciences, and Science in general, are in disadvantage when compared to other subjects. The school schedules (even for science post-16 pupils!) lack enough science sessions.
- Assessment activities should not pay attention just to concepts but also to pupils' skills and personal attitudes.
- Different curricula and even different teaching languages make the situation more complex: several publishing

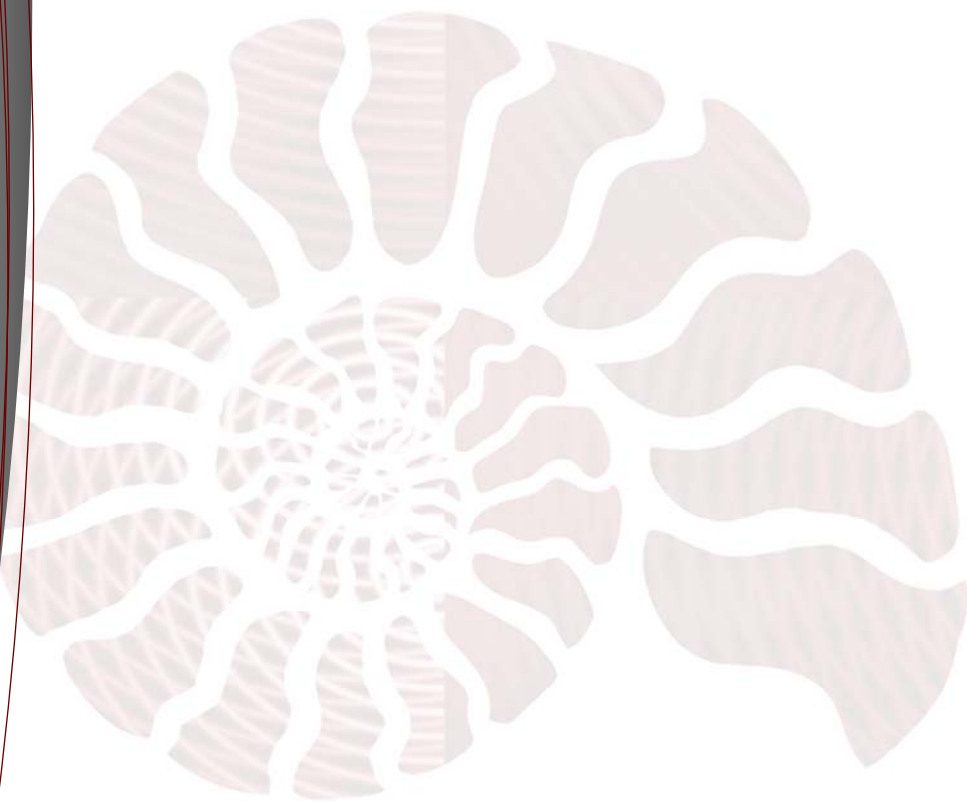
companies refuse to edit textbooks in some languages due to their small demand that reduces their benefits.

- Some aspects of the curricula can be found in different subjects of Science; as a result, pupils tend to learn these contents in a memoristic rather than in a practical way.

In this way, it is important to insist that Earth Sciences (or Geology) ought to be considered at the same level as: Biology, Chemistry or Physics. Geology provides responses to certain questions that are far from being superficial from a scientific point of view. Furthermore, Geology being a Science with a huge learning value has also an important cultural content. Knowledge regarding Planet Earth and the changes it has experienced through times is not a Life Science or Earth Science exclusive issue but a cultural good whose knowledge ought to be widespread within the society. Therefore, Geology has a basic role to play in scientific culture as well as in culture considered in a broad view.

Nonetheless, these are not good times for Geology and they result in the need to join forces for those who are committed with the teaching of this subject. From this point of view, associations and societies are a main platform to channel any kind of initiative targeted in this direction. It is evident that we cannot take care of what is unknown to us. Therefore, if we are knowledgeable about Our Planet, we may take care of it in appropriate conditions that guarantee the development of more healthy and prosperous societies avoiding risks. It is a commitment for all of us.





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"This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein."