2 The geosphere

LEARNING SITUATION

The geosphere in the home

In our home we are surrounded by a lot of different objects made from rocks and minerals.

For this task, you will create a **digital presentation** in which you will explain the different rocks and minerals that make up the objects which we use on a daily basis.

1 The origin of the Earth

The Earth is the third planet from the Sun. It's the only planet in our Solar System with water in its three states. The Earth is also the only planet where there is life. Our planet's unique conditions formed over millions of years.

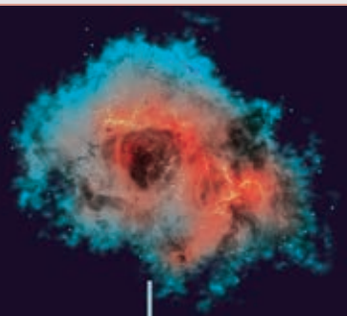
[1]**swirl:** something that turns in circles.

[2]**surround:** be all around something.

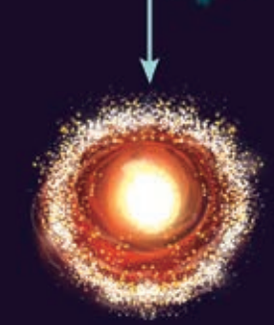
[3]**collide:** crash into each other.

[4]**primitive:** not fully developed yet.

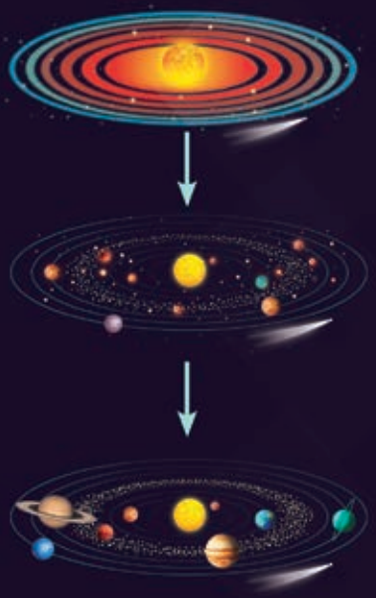
1. The Sun formed 4600 million years ago.



2. A **swirl**[1] of materials **surrounded**[2] the Sun.

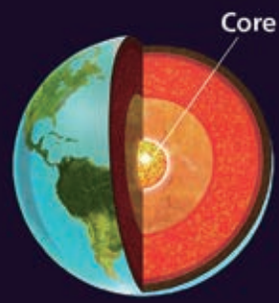


3. Materials **collided**[3] and formed larger celestial bodies called **planetesimals**.



4. Our **primitive**[4] Earth was extremely hot and there was a lot of volcanic activity.

5. The Earth started to cool down. Gravity pushed denser materials (such as iron) towards the core of the planet.

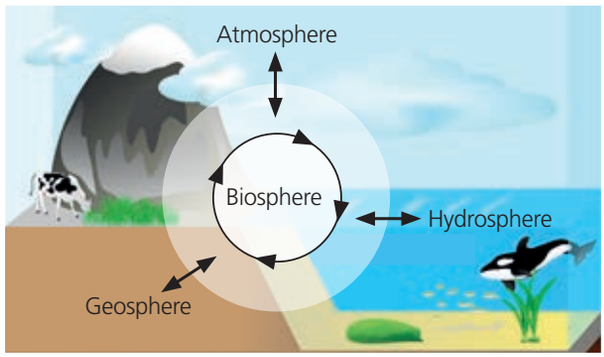


6. Temperatures in the Earth's inner layers were still very high.

Our planet has four main subsystems we call spheres:

1. the **atmosphere**, which is the gaseous layer.
2. the **hydrosphere**, which contains water in three states: liquid, gas and solid.
3. the **geosphere**, which is the solid part.
4. the **biosphere**, where life occurs.

The relationship between the different layers of the Earth is essential for life to develop.

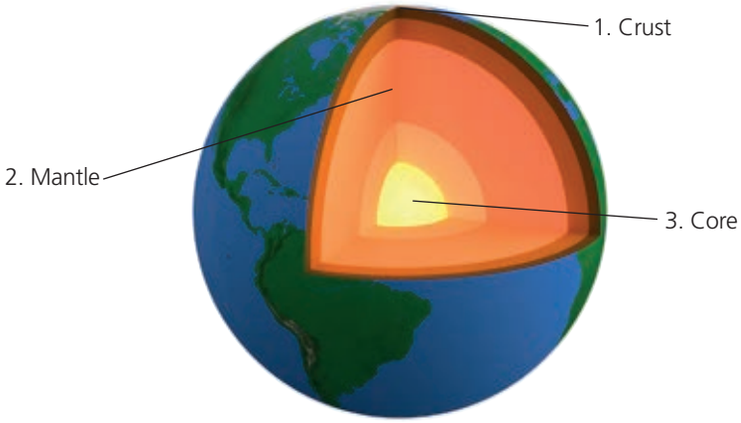


CLIL activities

1. **Why is the Earth a unique planet? In your notebook, write two of its characteristics and explain why they are important.**
2. **Listen to the students and correct any mistakes they make.**
3. **With a classmate, make a timeline about the origin of the Sun and the Earth.**

2 Layers of the geosphere

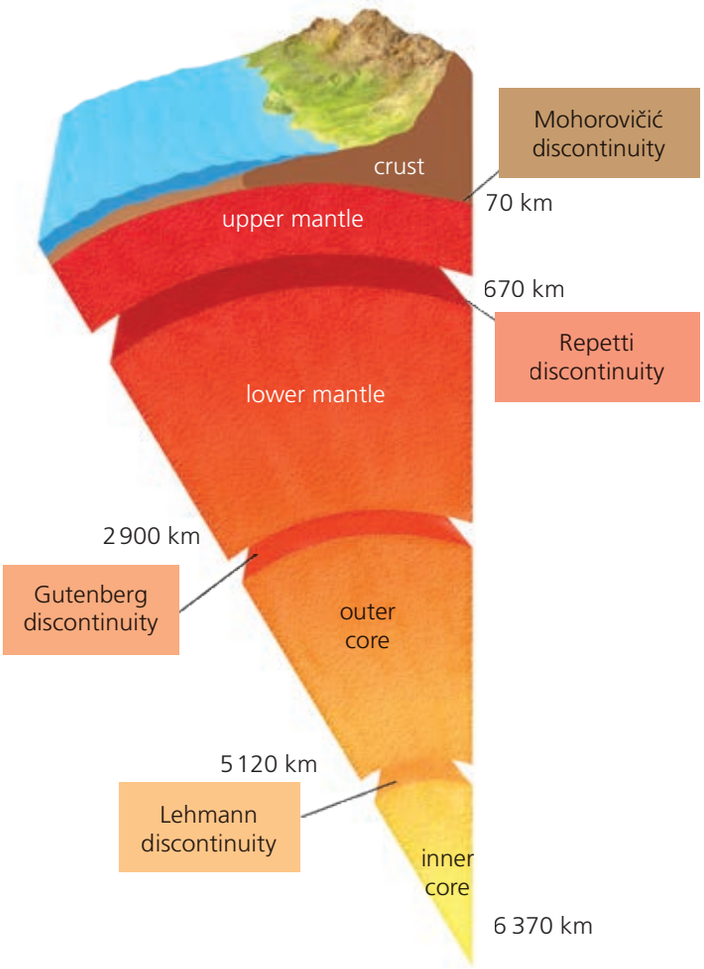
The **geosphere** has three **distinct**[1] layers: the crust, the mantle and the core. Areas called **discontinuities** separate each layer.



[1]**distinct:** clearly different.

[2]**molten:** made liquid because of extreme heat.

[3]**pressure:** force or weight of things pushing against each other.



1 The **crust** is the thin layer which covers the surface of the Earth.

- The **continental crust** is between 10 and 70 km thick. It's made of rocks, such as granite, clay and slate.
- The **oceanic crust** is between 6 and 70 km thick. It includes the ocean floor, which contains rocks such as basalt.

2 The next layer is the **mantle**. It's made of peridotite, which is a type of rock and it's divided into two parts:

- the **upper mantle**, which is mostly solid, with some areas that are **molten**[2].
- the **lower mantle**, which is denser than the upper mantle and contains solid materials.

3 The **core** is the inner and densest part of our planet. It's mostly made of iron, although there are other metals there, such as nickel. It's also divided into two layers:

- the **outer core**, made up of molten materials that continuously move.
- the **inner core**, the hottest part of the planet. It is mainly a solid ball due to extreme **pressure**[3].

CLIL activities

4 Listen to an extract from a radio series about a journey to the centre of the Earth. Identify each level in your notebook.

5 Finish the definition of the oceanic crust.

The oceanic crust is made of...

3 Minerals

Minerals are solid, inorganic, natural substances made up of atoms. The **arrangement**[1] of the atoms determines each mineral's **properties**[2].

The following properties can be used to identify minerals.

[1]**arrangement:** how things are put in order or organised.

[2]**property:** quality or characteristic.

[3]**dull:** not bright.

Shape of crystals: some minerals have crystals with recognisable shapes. For example, pyrite is shaped like a cube and aragonite has a hexagonal shape.

Aragonite

Pyrite

Streak: crushing a mineral produces dust. The colour of this dust is called its streak. The streak isn't always the same colour as the mineral.

Haematite and pyrite and their streaks

Colour: some minerals have a particular colour. Galena is a **dull**[3] grey, whereas sulphur is bright yellow. Other minerals, such as quartz, can have different colours.

Purple quartz

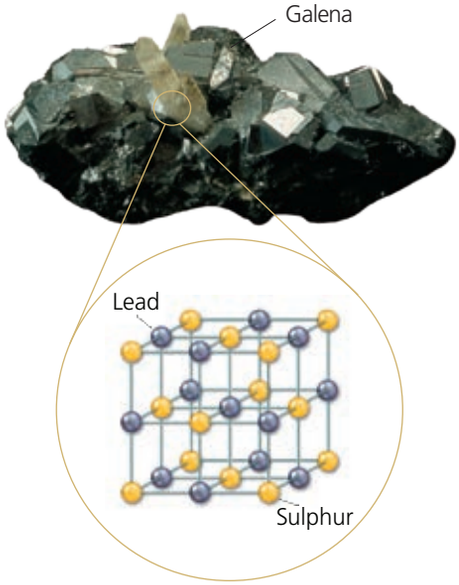
Lustre describes how a mineral reflects light. If it reflects light like a metal, it's metallic; if it's similar to glass (like fluorite), it's vitreous; if it's like a diamond, it's adamantine, and if it doesn't shine, it's dull.

Fluorite

Hardness describes a mineral's resistance to scratching. To check for hardness, we scratch two minerals against each other to see which mineral shows scratches on its surface. The **Mohs scale** uses numbers 1 to 10 to describe a mineral's relative hardness. Number 1 is the softest mineral (talc) because all minerals scratch it. Number 10 is the hardest mineral (diamond) because it scratches all other minerals.

Cleavage: a mineral cleaves if it breaks along smooth planes. For example, galena breaks into cubes and gypsum breaks into sheets.

Density: a mineral's mass and volume determine its density (density = mass/volume). We measure density in grams per cubic centimetre (g/cm^3). Each mineral has a specific density.



CLIL activities

6 STEAM Compare four common minerals. Write down their Mohs scale hardness grade in a table and use the data to draw a bar graph.

7 Listen to the students and identify the physical characteristics of minerals that they mention.

8 Imagine you hit a cubic crystal and it divides into smaller cubes. What property does this relate to?

9 Find out what a mineraloid is. Is the glass in a window a mineral or a mineraloid? Give reasons for your answer.

Mineral uses

Wherever you look you can see objects made using minerals. Any mobile phone contains at least ten different types of minerals.

Think about one of the rooms in your house and identify any objects that contain minerals.

a. *How many can you find?*

b. *Can they have other uses?*

Minerals are used mainly as **ores**, **raw materials** for industries, or as **gems** or precious stones.

Ores: these are minerals that contain metals that can be extracted from them. Only certain metals, such as gold, silver and platinum, can be found in a pure state in nature. We call pure forms **native metals**. Other metals need to be extracted from ores. Many minerals are ores.

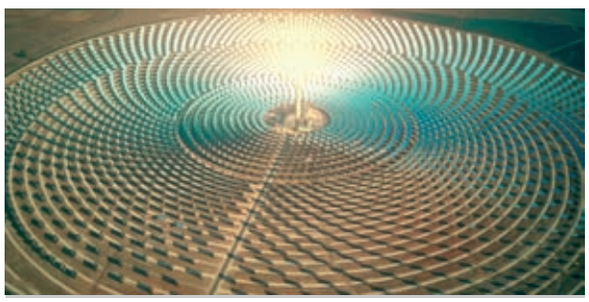
Native gold

Cinnabar

Ore	Metal
Bauxite	Aluminium
Blende	Zinc
Chalcopyrite	Copper
Cassiterite	Tin
Cinnabar	Mercury
Galena	Lead
Hematite	Iron

The principal ores of some metals

Raw materials for industry: uraninite is an ore of uranium, which we use as **fuel**[1] for nuclear power plants. **Quartz** is essential for the production of glass and solar panels. We use **gypsum** to make **plaster**[2], fertilisers and explosives.



Gems, or **precious stones:** these minerals are very **valuable**[3] because of their beauty and rarity. They are used to make jewellery after they are cut and **polished**[4].

Some popular gems are minerals, such as **diamonds**, **rubies** and **sapphires**.

Diamond

Ruby

Sapphire

[1]**fuel:** material that we burn to obtain heat or power.

[2]**plaster:** paste used for walls.

[3]**valuable:** people pay lots of money to buy it.

[4]**polish:** make something smooth and shiny by rubbing it.

CLIL activities

10 **Find information about how we use the following minerals:** bauxite, cinnabar, blende.

11 **In small groups, prepare a short presentation about the uses of minerals, then share with the class.**

4 Rocks

A rock is a solid, natural **aggregate**[1] of one or various minerals. Like minerals, rocks also have recognisable properties.

Composition: the minerals that make up the rock determine its composition. Some rocks are made up of a single mineral. Limestone, for example, is only made up of calcite. These types of rocks are called **simple** or **homogeneous**[2] **rocks**. Other rocks, such as granite, are made up of various minerals. These types of rocks are called **complex** or **heterogeneous**[3] **rocks**.

Texture: the size of the minerals and how they are distributed determines the texture of the rock. We have to use a **magnifying glass** or a **microscope** to observe a rock's texture accurately. These instruments allow us to identify the different minerals in the rock and to see the size of the minerals.

Exceptions!

There are a few exceptions, such as oil and coal, which don't come from minerals and don't contain them either.

[1]**aggregate:** mass which is made up of lots of smaller things.

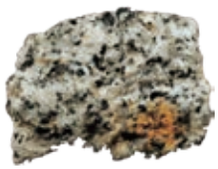
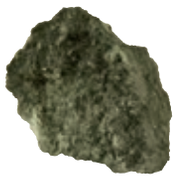
[2]**homogeneous:** consisting of things that are all the same, uniform.

[3]**heterogeneous:** consisting of many different kinds of things.

Types of rocks based on their origin

Igneous or magmatic rocks form when magma from the Earth's core cools down and solidifies. There are two types.

Volcanic rocks or **extrusive rocks** form when magma comes out of the Earth's crust as **lava**. Lava cools down quickly, forming volcanic rocks. **Plutonic rocks** or **intrusive rock**s form when magma stays inside the Earth's crust and cools down slowly. Identifying minerals in plutonic rocks is easier because the minerals had more time to form.

Volcanic		Plutonic	
			
Obsidian	Basalt	Granite	Gabbro

Metamorphic rocks are deep under the crust, where there is an enormous amount of **pressure** and very **high temperatures**. Pressure and temperature can change the composition of the rock.

According to their texture, metamorphic rocks can be **foliated** and **non-foliated**.

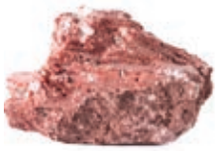
Foliated		Non-foliated	
			
Slate	Gneiss	Marble	Quartzite

CLIL activities

12 Find out the origin of coal and oil. Then write a short explanation of why they are exceptions.

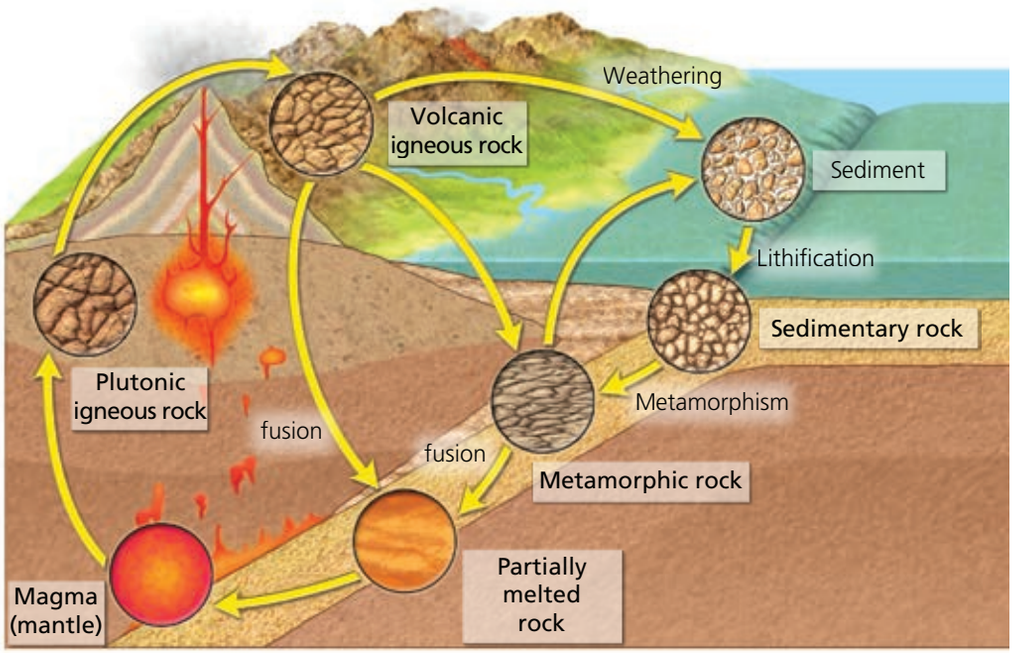
13 Listen to the statements and write *true* or *false*. Correct the false statements.

Sedimentary rocks come from **sediment**[1] that accumulates and **compacts**[2]. The process of transforming sediment into sedimentary rocks is called **lithification.** Depending on where the sediment came from, sedimentary rocks are **detrital** or **non-detrital.**

Detrital (rock sediment)		Non-detrital (sediment from the remains of aquatic living things or mineral salts)	
			
Conglomerate	Clay	Gypsum	Limestone

Lithification process

Sediment accumulates in the sedimentary **basin**[3]. Then it loses volume because of the weight of the sediment on top. Finally, the water disappears, leaving behind crystals. These crystals act like cement, joining the pieces together to form sedimentary rock.



The rock cycle

The **rock cycle** is all the processes and transformations that a rock **undergoes**[4]. Every rock in nature can transform into a different rock.

All rocks on the surface of the Earth	Action of water, wind... **Lithification**	**Sedimentary rocks**
Solid rocks in the Earth's interior	High pressure or temperature **Metamorphism**	**Metamorphic rocks**
Molten rock in the Earth's interior	If they solidify **inside** the Earth	**Plutonic igneous rocks**
	If they solidify **outside** the Earth	**Volcanic igneous rocks**

[1]**sediment:** accumulation of rock fragments and organic matter transported somewhere by water or wind.

[2]**compact:** press tightly together.

[3]**basin:** area of low land near large rivers.

[4]**undergo:** experience something, especially a change.

CLIL activities

14 For a rock to become metamorphic, does it have to be sedimentary?

How do we use rocks?

These are some ways in which differents types of rock are used:

- **Building materials:** we use some rocks as building materials. Others are processed to make them more suitable for building.

Cement is a mixture created by grinding and heating limestone and clay. You then mix the cooled powder with water and the mass solidifies when it dries. It's used to **bind**[1] materials such as stones or bricks.

Concrete is a mixture of cement, water, sand and gravel. Dry concrete is harder and stronger than cement. That's why we use concrete to build pillars and **foundations**[1].

Ceramics are made from pulverised clay mixed with water. You mould it into a specific shape and then bake it at high temperatures to make bricks, tiles or dishes.

We use the quartz found in sand to make **glass**. First, we melt the sand in an extremely hot oven. After it cools down, we mould the glass into lots of different shapes.

- **Ornamental rock:** marble, granite, slate and basalt are used to decorate our homes and gardens. These beautiful rocks are carved and polished to make sculptures or floors, as well as other decorative elements.
- **Source of fossil fuels:** sedimentary rocks, such as oil and coal, are used as fossil fuels. These fuels produce lots of energy when you burn them.
- **Source of minerals to make electronic devices:** silicon is obtained from rocks rich in quartz, such as quartzite. Silicon is used to make microprocessors and **solar panels**[3]. Aluminium comes from a sedimentary rock known as bauxite. We use aluminium to make many different things such as aeroplanes, soft drink cans or kitchen utensils.

[1]**bind:** stick together.

[2]**foundation:** solid underground base of a building.

[3]**solar panels:** devices that convert light into electricity.

Glass or crystal?

Although people confuse **glass** and **crystal** they aren't the same and are related to different compounds. The main difference between glass and crystal is the lead-oxide which is added to crystal giving it a characteristic shine and transparency.

CLIL activities

15 Can you name four construction materials that come from rocks?

16 What types of rock are mainly used for ornamental purposes?

17 With a classmate, take turns describing different uses of rocks for the other to guess. Write down your best example.

5 The extraction of minerals and rocks

Minerals are extracted in particular locations of the Earth's crust where there are deposits of the mineral. We call these exploitations mines.

The valuable minerals are called ores. The other valueless minerals found together with the ores are known as gangue.

Depending on how deep and how accessible ores are, mines can be on the Earth's surface or underground.

Open cast mine

Underground mine

Just like minerals, rocks need to be extracted from deposits. These extractions take place in gravel pits and quarries.

Like mines, quarries can be classified into surface, or open, quarries or underground quarries, depending on the depth at which they are found.

Open air quarry

Underground quarry

The sustainable management of mineral resources

Obtaining minerals in an **unregulated**[1] way can have negative consequences, such as the **contamination**[2] of water and soil, or health problems for the people who handle the minerals.

It is important to obtain these resources safely and **sustainably**[3] to avoid problems like these. Recycling minerals and the products that contain them are also ways to help the environment.

[1]**unregulated:** not controlled by laws.

[2]**contamination:** process of making something dirty.

[3]**sustainably:** in a way that causes little damage to the environment.

CLIL activities

18 Why is it extremely important to manage mineral resources sustainably?

19 What type of quarry is more environmentally-friendly, an open quarry or an underground quarry? Which is more technologically advanced? Find pros and cons related to both types of quarries.

6 Geological areas of Andalucía

There are various geological areas in Andalucía.

- **Sierra Morena** is a mountainous area in the north. It is a visibly **eroded**[1] area with a lot of slate, granite and quartzite.
- The **Baetic mountain ranges** are in the south and are less eroded. The most common sedimentary rock on the highest mountains (Sierra Nevada and Sierra de las Filabres) is shale. There are carbonate rocks, such as limestone and marble, on the other mountains in this area.
- The **Guadalquivir Depression** and recent basin formed as a result of river erosion affecting the Baetic mountain ranges.
- The **coastal areas of Andalucía** are in the south and southeast. The geological compositions of these areas are different on the Atlantic and Mediterranean coasts.

[1]**eroded:** slowly damaged or destroyed by wind, rain or ice.

[2]**heritage:** of great historical or cultural importance.

[3]**strata:** layers of rock.

[4]**extinct:** doesn't exist today.

Andalucía's geological heritage

Managing geological resources and landscapes is a vital part of preserving geological **heritage**[2]. That is why a catalogue called the *Inventario Andaluz de Georrecursos* exists. The main objective of this inventory is to **identify** and **protect** the most important landforms in Andalucía:

Cavities, including karsts, where caves usually form.	**Mining** regions, where there are old mines.	Regions with rare **minerals** and **rocks**.
		
Nerja cave (Málaga)	Mine ruins (Jaén)	Graphite

Stratigraphic and palaeontological sites help us understand the geological history of Andalucía. Stratigraphy is the study of **strata**[3], and palaeontology is the study of prehistoric species, especially species which are **extinct**[4].

Geomorphological resources include sites that are beautiful or rare. They are the most common resources in the catalogue.


El Torcal, Antequera (Málaga)


Cabo de Gata (Almería)

CLIL activities

20 Answer the following questions.

a. How does strata form

b. Why is stratigraphy an interesting subject to study?

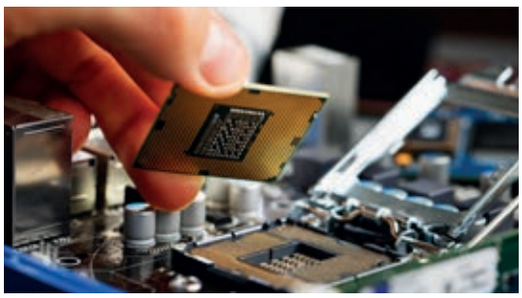
21 In groups, design a leaflet for young geotourists in Andalucía. Share your leaflets with the class.

22 Listen and write three bullet points about geotourism in your notebook.

The geosphere in the home Digital presentation

Rocks and minerals are essential raw materials. We use them to make an enormous number of objects for daily life as well as in many other areas such as industry, construction and in environmental applications.

The list of rocks and minerals that humans make use of is so long that most people don't know all of them. In fact, we often don't realise that things we use or see every day are made using rocks and minerals.



The **aim** of this task is to raise awareness of the importance of minerals in our daily life. To do this, you will find out about the different materials that make up parts of your home or buildings you visit often, as well as the objects in your home that are made using rocks and minerals. You will make a **digital presentation** to include the information you find and a photo album or display of all the structures and objects that come from rocks and minerals.

Research

1. **Make a list of structures and objects that you can find in a home that you think it is possible to make using rocks or minerals. Organise the list according to the rooms of a house.**
2. **Analyse the list and exclude the elements in *your* home that you think are made of other materials, such as wood or synthetic plastic.**
3. **Find information about the manufacturing process of the items on your list. How many are made in Spain?**
4. **When you have this information, remove from the list anything that is not made of rock or mineral.**
5. **Take a photo of each structure or object that remains on your list. Organise them on the basis of the rooms where you found them.**

Development

6. **To organise the information you have collected, make a digital presentation. Follow these steps:**
   - Organise the presentation into sections, dividing the elements into structures, such as walls, floors and ceilings, and objects, such as electrical devices, equipment and tools.

     Also organise them into groups according to the different rooms in your home where you can find them.
   - On each slide, include the name of the structure or object, the photo and the mineral or rock used to manufacture it.

Remember to include the following in your presentation:

- A brief introduction to the topic you have researched
- Images and detailed information about the objects you analysed
- A final evaluation of the importance of rocks and minerals in our lives, as well as measures we can take to make the best and most sustainable use of these resources
- A bibliography of all the sources you consulted (texts and images)

Share your findings

7. **Present your work and together with all your classmates, make a definitive list of the everyday materials and objects around you that are made from rocks or minerals.**