Biology and Geology 1.º ESO

# Reinforcement plan 1

## Biology and Geology 1.º ESO

Addressed to students with 1st year of ESO pending subject.

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## UNIT 1. THE SCIENTIFIC METHOD

Scientific knowledge involves a specific language and its own method of investigation called the scientific method.

| Scientific method steps | Example | |
|---|---|---|
| **1. Question**<br>As scientists observe nature they ask themselves a series of questions. |  | In the past scientists thought that living things could come from non-living things, like air or water. Others did not think this was possible. |
| **2. Hypothesis**<br>A hypothesis is a provisional answer to the question proposed. |  | The Italian doctor Francesco Redi was convinced that living things could not come from non-living things. |
| **3. Experiment**<br>Experiments are done under controlled conditions to check if the hypothesis formulated is correct. Experiment design is the most complex and creative step of the scientific method. |  | In 1668, in order to prove this hypothesis, Redi completed the following experiment: he put raw meat in three glass jars: one covered with cork, one with material, and the third one uncovered. |
| **4. Analysis of results and confirmation of hypothesis**<br>Analysis is the study of the results of the experiment to prove whether the hypothesis is true or false. |  | After three weeks he proved that there were maggots only in the open jar, in the one which flies could enter and lay eggs. He therefore proved that maggots did not come from meat or air, but from the flies. |

When a hypothesis is not proved correct, by the results of the experiment, a new hypothesis has to be made along with a new set of experiments to prove whether it is true or not.

## Activities

1. **Create a hypothesis for <u>one</u> of the questions below.**

**Question 1: Why is the sky light during the day but dark at night?**

**Question 2: Why does a candle extinguish when you place a glass over it?**

2. **Design an experiment that would allow you to test if question 2 in activity 2 is correct. You have access to the following materials: a candle, matches, a plastic glass with small holes, and an identical plastic glass with no holes.**

**Science and the stages of the scientific method**

**Science**

Science is the continuous search for answers to questions about natural phenomena. This search follows a process of investigation, the scientific method. The scientific method allows us to deduce the laws governing nature.

Through the scientific study of nature, humans develop answers that help us to understand how natural phenomena occur. For example, we can now explain what causes volcanoes and earthquakes, why flowering plants and why the Moon does not always look the same.

**Pseudoscience**

Not all answers or explanations are scientific. Pseudoscience is the name given to all disciplines that try to answer questions about natural phenomena using scientific language, but without conducting experiments to prove it.

For example, a pseudoscientist may state that volcanoes and earthquakes a punishment that nature itself inflicts on the people who live there.

**Activities**

**3.** Read the statements. Write science (S) or pseudoscience (P).

Earthquakes are the result of the sudden release of violent energy from the Earth's interior and violently: ___

Earthquakes are the result of a punishment by the gods send: ___

Depending on the year in which a person is born, the arrangement of the stars influence their personality: ___

The personality of an individual is influenced by their genetics and their education: ___

If you wear a piece of yellow clothing your test will go badly because the colour yellow gives bad luck: ____

If you do not study enough, the test will go wrong: ____

**4.** Match the following words using arrows:

| | |
|---|---|
| Biologist | |
| Seer | |
| Magician | Scientist |
| Geologist | |
| Doctor | Pseudoscientist |
| Tarot reader | |
| Pharmacist | |

## UNIT 2. GEOSPHERE

**Origin of Solar System**: About 4.6 billion years ago, the Sun formed, surrounded by a swirling mass of materials. These materials began to collide and form larger bodies known as planetesimals, which eventually gathered to give rise to the planets, including Earth. At first, our planet was extremely hot, with intense volcanic activity on its surface. As it cooled, gravity organised the materials according to their density: heavier elements, like iron, sank towards the core, while lighter materials remained in the upper layers. Despite the cooling, Earth's inner layers still maintain very high temperatures, especially in the core.

**The Earth's interior** is composed of several structural layers. The outermost layer is the **crust**, divided into **continental** and **oceanic crust**, with the continental crust being thicker but less dense than the oceanic crust. Then we have the **mantle**, which is also divided into the upper and lower mantle. Between the crust and the mantle lies the **Mohorovičić discontinuity** (Moho), and between the **upper and lower mantle** is the **Repetti discontinuity**. Further down is the **Gutenberg discontinuity**, which separates the mantle from the core, which is subdivided into the **outer core (liquid) and inner core (solid)**. The **Lehmann discontinuity** marks the boundary between the outer and inner core.

Regarding the crust, mantle, and core, each of these parts has notable differences in **composition and physical characteristics**. The crust, for instance, is much thinner and consists of various minerals, while the mantle is primarily composed of dense silicates that are solid but can flow slowly over time. The core is mainly made of iron and nickel and is differentiated into a liquid outer core and a solid inner core due to the extreme pressure in that region.

The components of the crust and mantle are minerals and rocks. **Minerals** have specific essential characteristics: they are solid substances, meaning they are neither liquids nor gases in their natural state; they are inorganic, which means they do not come from living things; and they have a natural origin, implying that they are not manufactured by humans. Furthermore, each mineral has a defined chemical composition and displays a crystalline structure, meaning its particles are arranged in specific, orderly geometric forms.

Each mineral also has **optical properties** that facilitate its identification. Among them, the habit refers to the shape in which crystals grow; streak is the colour of the powder left by the mineral when scratched on a surface; colour may vary but is not always reliable for identification; and lustre indicates how it reflects light, which can be vitreous, metallic, or silky, among others.

The density of minerals varies, as it depends on their composition and internal structure. Not all minerals have the same density, allowing them to be differentiated based on this specific value.

The **Mohs scale** is an important tool for measuring the hardness of minerals. This scale ranks minerals from 1 to 10 according to their ability to scratch other minerals or be scratched by them, helping to identify each mineral's resistance in a simple way.

**Other physical properties** include **hardness**, which is the resistance of a mineral to being scratched; cleavage, describing its ability to split into sheets or planes when broken; and density, which is the ratio between the mineral's mass and volume.

**Rocks** are always composed of one or more minerals, and there are different types of rocks: **igneous, metamorphic, and sedimentary**. Volcanic igneous rocks, like basalt and pumice, form

when magma cools quickly on the Earth's surface, preventing minerals from forming large crystals. In contrast, plutonic igneous rocks, like granite, form inside the Earth, where cooling is slower, allowing the formation of large, visible crystals. Granite is composed of quartz, mica, and feldspar.

Some examples of sedimentary rocks are sandstone, formed from the accumulation and compaction of sand; limestone, mostly composed of calcium carbonate; and conglomerate, formed from larger rock fragments cemented together. On the other hand, metamorphic rocks, such as marble, slate, and schist, originate when other rocks are subjected to high pressures and temperatures, causing changes in their structure and composition without melting.

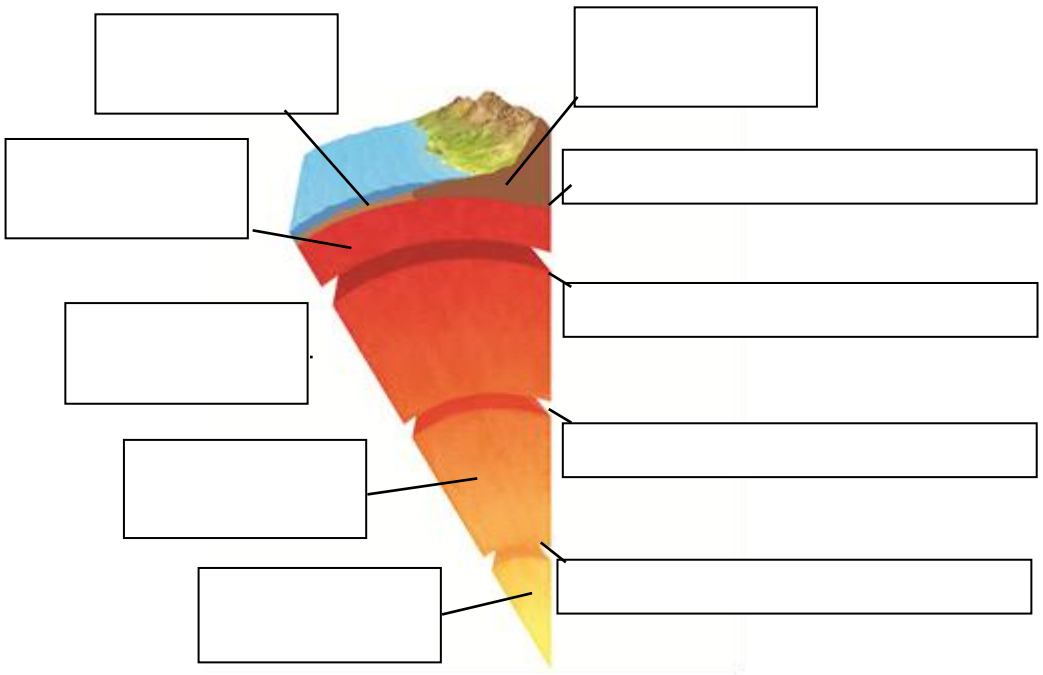
The **rock cycle** is a continuous process that explains how rocks can transform over time. Igneous rocks, created from the cooling of magma, can undergo erosion and sedimentation, transforming into sedimentary rocks. These, in turn, can become buried and experience heat and pressure, turning into metamorphic rocks. If the metamorphic rocks melt again, magma forms, and the cycle begins anew, demonstrating how rocks change and evolve over time in a cyclical and dynamic process.

**ACTIVITIES UNIT 2:**

1. **Organise the following sentences about the origin of Solar System and our planet.**

   - The Earth started to cool down. Gravity pushed denser materials (such as iron) towards the core of the planet. _____
   - The Sun formed 4 600 million years ago. _____
   - Materials collided and formed larger celestial bodies called planetesimals. _____
   - Temperatures in the Earth's inner layers are still very high. _____
   - A swirl of materials surrounded the Sun. _____
   - Our primitive Earth was extremely hot and there was a lot of volcanic activity. _____

2. **Complete the diagram below of the Earth's interior. Use these words: continental crust, upper mantle, Moho discontinuity, oceanic crust, outer core, inner core, lower mantle, Gutenberg discontinuity; Repetti Discontinuity; Lehmann discontinuity.**



3. **What are the differences between the continental crust and the oceanic crust, and the mantle and the core?**

**4. Match the characteristics of minerals with their meanings.**

| | |
|---|---|
| **1. They are solid substances** | **a. Their particles are arranged in a way that forms geometric structures.** |
| **2. They are inorganic** | **b. They are always formed by the same chemical element** |
| **3. They have a natural origin** | **c. They are not human-made** |
| **4. They have a definite chemical composition** | **d. They are not produced living things.** |
| **5. They present a crystalline structure** | **e. They are not liquid or gas.** |

**5. Define a mineral's optical properties.**

- **Habit:**
- **Streak:**
- **Colour:**
- **Lustre:**

**6. Is the density of all minerals the same? Support your answer.**

**7. Why is the Mohs scale useful?**

**8. Explain hardness, cleavage and the density of minerals in your own words.**

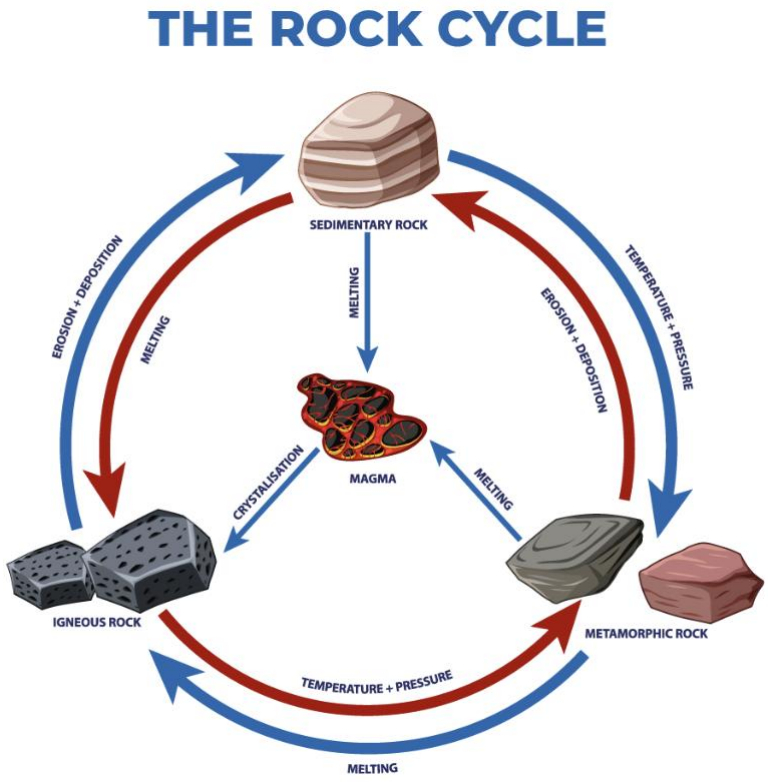
9. **Write 3 examples of volcanic igneous rocks.**

10. **Explain the difference between the formation of volcanic igneous rocks and plutonic igneous rocks.**

11. **Give 3 examples of sedimentary rocks.**

12. **Give 3 examples of metamorphic rocks.**

13. **Explain the following diagram about the cycle of rocks:**



## UNIT 3. HIDROSPHERE

The **hydrosphere** is the layer of water covering much of the Earth's surface. It includes oceans, seas, rivers, lakes, glaciers, groundwater, and water vapour in the atmosphere. The water on Earth is primarily distributed in the oceans, which contain about 97% of the total and is saltwater. Only 3% is freshwater, and of that percentage, only a small fraction is accessible and drinkable for humans, as much of it is stored in glaciers and ice caps.
The water cycle is essential for the distribution and conservation of water on Earth. It begins with evaporation, a process in which the Sun heats the water in the oceans and continental surfaces, causing it to change from liquid to gas. Plants also contribute through transpiration, releasing water vapour into the atmosphere, which helps to maintain humidity and regulate temperature. This water vapour rises and condenses into clouds, which then release the water as rain, snow, or hail in the process of precipitation. This precipitation plays a crucial role in distributing water across different areas, especially in agricultural regions. Part of this water flows across the Earth's surface as surface runoff, moving towards rivers, lakes, and eventually the sea. Another portion infiltrates the soil, forming groundwater, which supplies aquifers—important freshwater reserves for human consumption and agriculture.
There are different **uses of water** depending on whether it returns to its original source after use:

- A **consumptive use** implies that the water extracted is not returned to its place of origin. An example of this is agricultural irrigation, which consumes large amounts of water, often without returning it to the system.
- In a **non-consumptive** use, the water extracted is used without being lost elsewhere and may return to its origin. For instance, in the cooling of some industries, water is used and then returned to the same water body.

Water has unique **characteristics and properties** that make it essential for life. It is a substance formed by three atoms: two hydrogen atoms and one oxygen atom. It is colourless (without colour) and tasteless (without flavour), making it easy to consume and use in various processes. At room temperature, water is in a liquid state and is known as the universal solvent due to its ability to dissolve a large number of substances, allowing essential chemical reactions for life. Additionally, water has a high thermal capacity, meaning it can absorb and release large amounts of heat without changing temperature quickly. This characteristic is crucial for climate regulation and stabilising temperatures in aquatic ecosystems. Its surface tension is also high, allowing some organisms, such as certain insects, to move on its surface.
Water exists in **three states** on Earth, each serving an important role:

- In its solid state, it is found in glaciers, ice, and snow, which act as freshwater reserves and help regulate the climate by reflecting much of the sunlight.
- In its liquid state, water appears in lakes, rivers, seas, oceans, and as groundwater, and is essential for the carbon cycle and nutrient transport in ecosystems.
- In its gaseous state, water vapour in the atmosphere contributes to the greenhouse effect, helping to maintain the planet’s temperature within a suitable range for life.

Each of these aspects highlights the importance of the hydrosphere on Earth, as it regulates the climate, enables

**ACTIVITIES UNIT 3**

1. **What is the hydrosphere?**

2. **Complete the text with the missing words.**

| | | |
|---|---|---|
| groundwater | clouds | snow |
| Sun | transpiration | surface runoff |

The _____ evaporates seawater and continental water. Plants also release water vapour by _____. This water vapour condenses do form _____ where the water then falls as rain, _____ or hail. The water from precipitation runs over the Earth's surface as _____, carrying the water to the sea. Part of the precipitated water infiltrates into the ground forming _____.

3. **Fill in the blanks with the correct word.**

| | | | |
|---|---|---|---|
| **origin** | **consumptive** | **remains** | **non-consumptive** |

The **_____** use of water is when an amount of water extracted from its place of **_____** to be used elsewhere without being returned.

The **_____** use of water is when the amount of water that, once used, **_____** in the same place it was obtained.

4. **Choose the correct word of the two options to complete the sentence correctly.**

   **a)** Water is a substance made up of ( one / three atoms ).

   **b)** Water is made of hydrogen and ( oxygen / nitrogen ).

   **c)** Water is transparent because it is ( odourless / colourless ).

   **d)** Water does not have any taste because it is ( odourless / tasteless ).

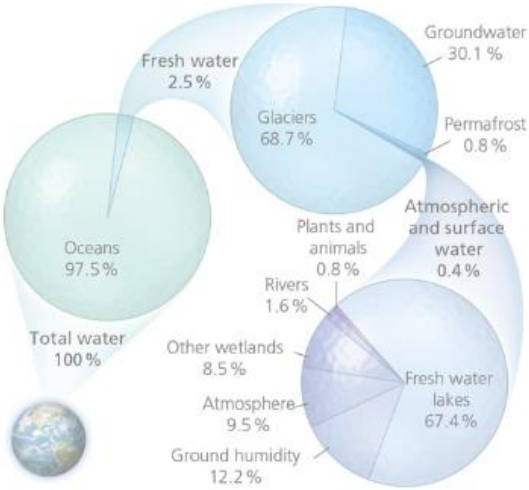
   **e)** At room temperature water is in a ( solid / liquid ) state.

   **f)** Water can dissolve many substances, for this reason it is known as the ( universal solvent / universal solute).

5. **Match the different types of water with its state:** Glaciers; Lakes; Water vapour; Ice; Seas; Oceans; Snow; Rivers; Underground water.

| Solid | Liquid | Gas |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

6. This diagram shows the distribution of water on Earth. Using the information complete the following text.




The hydrosphere is the mass of water present on Earth. Of the total amount of water present on Earth, only _____ is fresh water. Of this, only _____ is

**UNIT 4. ATMOSPHERE**

The **atmosphere** is the layer of **gases** surrounding the **Earth**, providing **protection** and enabling the right conditions for **life**. Although it is mostly invisible and seems lightweight, it has a significant influence on the **climate**, regulates **temperature**, and filters certain types of **solar radiation** that could be harmful to living beings. Without it, life on our planet would not be possible, as it helps **retain heat** and shields against the Sun's harmful **ultraviolet rays**.

The atmosphere is divided into four main **layers**:

1. The **troposphere**, which is the layer closest to the Earth's surface, where most **weather phenomena** occur.
2. The **stratosphere**, which contains the **ozone layer** that absorbs a large portion of **ultraviolet radiation**.
3. The **mesosphere**, where **temperatures** decrease and which can destroy **meteors** attempting to enter Earth.
4. The **thermosphere**, the outermost layer, which can reach very high temperatures and extends into **outer space**.

Some statements about the atmosphere are incorrect and should be clarified:

- The **atmosphere** is not composed solely of **gases**; it also contains **dust particles**, **water vapour**, and other **aerosols**.
- Although **nitrogen** (78%) and **oxygen** (21%) are the most abundant gases, the atmosphere also contains small amounts of other gases, such as **carbon dioxide**, **argon**, and **water vapour**.
- **Oxygen** is not produced during **respiration** but rather through the process of **photosynthesis**, which is carried out by **plants** and other **photosynthetic organisms**.
- **Gravity** indeed pulls denser gases down to the lower layers, such as the **troposphere**, which is closer to the Earth's surface.
- **Oxygen** is indeed the second most abundant gas in the atmosphere after **nitrogen**.

The **ozone layer** in the stratosphere is a crucial part of the atmosphere, as it protects us from **solar radiation**. **Radiations** such as **ultraviolet rays** are harmful to living beings. The atmosphere as a whole, and the ozone layer in particular, are responsible for absorbing these **radiations** so that they do not reach the Earth's surface in harmful amounts.

There are various characteristics of **radiation** and the role of the **atmosphere** in managing it:

- **Ultraviolet rays** are the type of **solar radiation** that causes the most harm.
- **CFCs** (chlorofluorocarbons) are the main agents responsible for the **holes** in the **ozone layer**.
- The **ozone layer** is located in the **stratosphere** and performs its protective role from there.

Important processes and phenomena also occur in the atmosphere, such as the **greenhouse effect**, which is a natural mechanism that allows the atmosphere to retain

some of the **Sun's heat**, maintaining the temperature suitable for **life**. Major **greenhouse gases** include **carbon dioxide** and **water vapour**, which, in normal concentrations, help maintain a **thermal balance**. **Forests** are vital areas where **carbon dioxide** is absorbed, reducing the impact of this gas in the atmosphere. However, **global temperature** is changing due to **global warming**, affecting both **climate** and **ecosystems**.

These concepts illustrate how the **atmosphere**, in addition to providing **oxygen**, protecting and retaining heat, plays an essential role in **climate balance** and the protection of all living beings on the planet.

**ACTIVITIES UNIT 4**

1. **What is the atmosphere?**

2. **What are the 4 main layers in the atmosphere?**

3. **Decide if these statements are true or false. Correct the false statements.**
   - The atmosphere is only composed of gases.
   - Nitrogen and oxygen are the only gases found in the atmosphere.
   - Oxygen is produced during the process of respiration.
   - Gravity pushes the densest gases towards the layers closest to the Earth's surface.
   - Oxygen is the second most abundant gas in the atmosphere.

4. **Decide if these statements are true or false. Correct the false statements.**
   - The atmosphere is only composed of gases.
   - Nitrogen and oxygen are the only gases found in the atmosphere.
   - Oxygen is produced during the process of respiration.
   - Gravity pushes the densest gases towards the layers closest to the Earth's surface.
   - Oxygen is the second most abundant gas in the atmosphere.

5. **Complete the text with the correct word (ultraviolet, ozone layer, atmosphere).**
   The _____ protects us from solar radiation. Some radiation, such as _____ rays, is very harmful to living things. The _____ layer is responsible for absorbing these rays.

6. **Choose the correct answer for each of the following statements.**
   - An example of solar radiation that causes damage.
     a) Visible light b) Infrared rays c) Ultraviolet rays
   - The main agent responsible for the holes in the ozone layer.
     a) Greenhouse gases b) CFCs c) Ozone

- The ozone layer is situated in the …
  a) Stratosphere b) Thermosphere c) exosphere

**7.** Match each word with the correct description.

| | |
|---|---|
| Climate | A natural phenomenon by which the atmosphere retains some of the heat from the Sun. |
| Greenhouse effect | The greenhouse effect maintains this at a suitable level for Earth's organisms to live. |
| Carbon dioxide | Two of the main greenhouse gases. |
| Water vapour | A place where photosynthetic organisms absorb carbon dioxide that humans are destroying. |
| Temperature | The form water is found in the atmosphere. |
| Forests | Changing due to global warming. |

## UNIT 5. ECOSYSTEMS

An **ecosystem** is the collection of **living beings** that inhabit a specific location along with the **non-living or abiotic factors** that surround them. There are different types of ecosystems, such as **terrestrial ecosystems** (forests, deserts, grasslands) and **aquatic ecosystems** (seas, lakes, rivers), each with its own characteristics and species. In an ecosystem, organisms interact with each other and with the environment, forming a network of relationships that allows for **survival** and **balance**.

Within an ecosystem, there is a distinction between a **population** and a **community** or **biocenosis**. A **population** consists of individuals of the same species living in a given area, while a **community** includes all the populations of different species that interact in the same place.

The **abiotic factors** of an ecosystem are those elements that are non-living but influence the living beings, such as **sunlight**, **water**, **temperature**, **soil**, **humidity**, and **wind**. These factors vary from one ecosystem to another and determine which organisms can live in each location. For example, in a warm desert, low humidity and high temperatures create extreme conditions for survival, while in a tropical rainforest, high humidity and constant temperatures favour **biodiversity**.

The **food relationships** in ecosystems are organised into **trophic levels**. **Producers** (such as plants and algae) are the first level, as they convert solar energy into organic matter through **photosynthesis**. From there, **primary consumers** (herbivores), **secondary consumers** (carnivores), and **tertiary consumers** (carnivores that eat other carnivores) pass energy through the food chain. A **food chain** is a linear sequence where each organism feeds on the previous one and serves as food for the next. In contrast, a **food web** is more complex, representing multiple interconnected food chains, showing how organisms can have several food sources and multiple consumers.

Organisms that depend on others for organic matter are divided into two main groups:

- **Consumers**, which obtain their energy by feeding on other living beings. They can be herbivores, carnivores, or omnivores depending on their diet.
- **Decomposers**, which feed on decaying organic matter and transform the remains of dead organisms into nutrients that return to the soil. This means that "decomposers close the cycle of matter", as they allow nutrients to reintegrate into the ecosystem and be available for plants, thus completing the cycle of life.

Many birds migrate to find better conditions of **temperature**, **food**, and **breeding** at different times of the year. This also allows them to avoid extreme cold or resource shortages in their places of origin. For example, the **white stork** travels from Europe to Africa during winter to avoid the cold, while the **swallow** migrates in search of warm areas with more food for its young.

Regarding the **adaptations** of organisms, there are three main types:

- **Morphological adaptations** refer to changes in the structure of the organism, such as its size and shape. For example, animals like bears have fat and thick fur that protect them from the cold.
- **Behavioural adaptations** relate to changes in the actions or habits of animals, such as patterns of activity. Some animals, like owls, are nocturnal and sleep during the day, adapting better to their environment and hunting conditions.
- **Physiological adaptations** are related to internal changes in the organism. For example, some animals can reduce their metabolism during winter in a state called **hibernation** to conserve energy.

The **biomes** of the planet are grouped into different **climatic zones** according to the predominant climate type and are characterised by their specific organisms and environmental conditions:

- **Cold climate biomes** include the **tundra**, **taiga**, and **cold deserts**. The tundra, with extreme temperatures and low vegetation, is home to organisms adapted to the cold, while the taiga, or boreal forest, features conifers that withstand long winters and short summers.
- **Temperate climate biomes** comprise **deciduous forests**, **Mediterranean forests**, and the **steppe**. The deciduous forest is characterised by trees that lose their leaves in autumn, while the Mediterranean forest has species adapted to dry, warm summers. The steppe, in turn, is a grassland with scattered herbs and shrubs, adapted to dry conditions.
- **Warm climate biomes** encompass **tropical rainforests**, **savannas**, and **warm deserts**. The tropical rainforest, located in areas near the equator, is the biome with the highest **biodiversity**, with constant rainfall and dense vegetation. The savanna is characterised by large areas of grassland and scattered trees, with alternating seasons of rain and drought. Warm deserts exhibit extreme temperatures and very little vegetation, while cold deserts, such as in polar regions, are areas with low precipitation and low temperatures.

This organisation and the different types of adaptations allow organisms to survive and thrive in the varied ecosystems of our planet.

**ACTIVITIES UNIT 5**

1. **What is an ecosystem?**

2. **What is the different between a population and a community (biocesis)?**

3. **Indicate some abiotic factors in an ecosystem:**

4. **Explain the difference between a food chain and a food web.**

5. **How do we classify groups of organisms that obtain organic matter from other living things? Give a short description of the two groups.**

6. **Explain what 'decomposers close the cycle of matter' means.**

7. **Explain why many birds migrate. Give some examples.**

8. **Fill in the blanks with the words from the box to complete the text.**

| behavioural | cold | shape | nocturnal |
|---|---|---|---|

**Morphological adaptations are related to the organism's structure, such as its size and _____. Some animals, such as bears, have adaptations such as fat and fur that protect them from the _____.**
**_____ adaptations deal with behaviour, such as migration patterns. Some animals are _____, and sleep during the day.**

**9. Classify each biome in the box into its corresponding climate zone.**

| |
|---|
| tundra savannah Mediterranean forest taiga deciduous forest<br>hot deserts polar desert steppe rainforest |

| **Cold climate zone** | **Temperate climate zone** | **Warm climate zone** |
|---|---|---|
| | | |
| | | |
| | | |