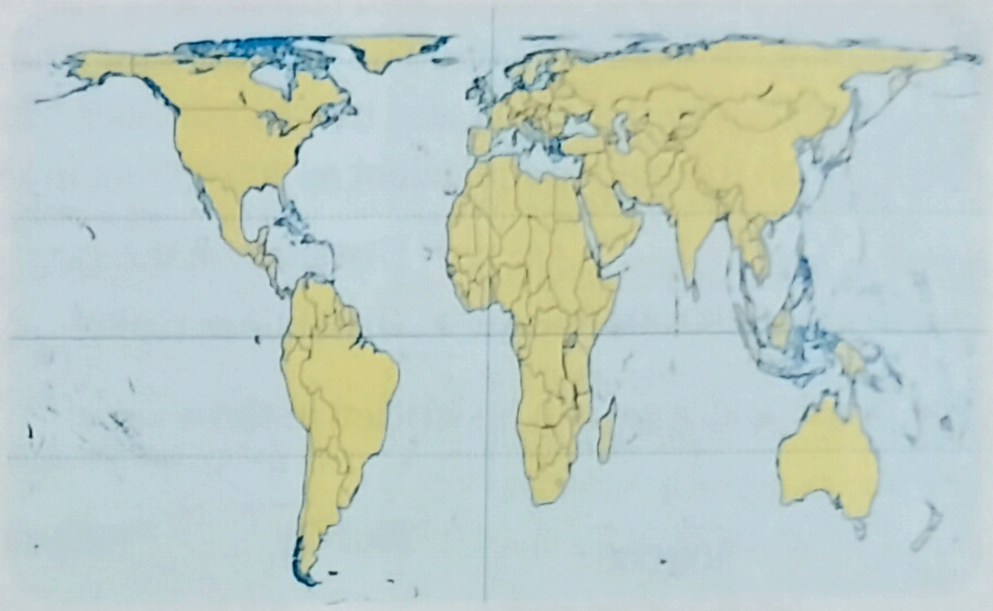
EXPLORE

Mercator and Peters projections

The **Mercator projection** is a cylindrical projection created in the 16th century by Gerardus Mercator. It distorts the size of the regions as they move away from the Equator. (9) This is why Greenland, for example, looks bigger than in reality.

In the 20th century, **Arno Peters** developed a cylindrical projection to correct the errors of the Mercator maps. Peters' projection preserves the proportions between the Earth's regions, but distorts the shapes. (10)

9. World map with the Mercator projection



10. World map with the Peters projection

Investigate

- Look at several maps in your atlas. Identify the type of projection used in each map.
- Investigate the AuthaGraph projection. Explain the advantages and disadvantages of this projection.

Features of maps

Maps contain features that help us to interpret them. (11)

A. A **title** with information about the map.

B. A **key** with the symbols and colours used on the map.

C. A **scale** showing the proportion between the map and reality.

D. The **orientation**.

E. Various **text labels** with information.

F. Lines of **latitude** (parallels) and **longitude** (meridians) to locate any point on Earth.

Locate points on a map

Latitude is indicated by the numbers on the right and left of the map.

Longitude is indicated by the numbers at the bottom and top of the map.

How to do it

To find the exact position of a place:

- **Find the latitude and longitude.** Both coordinates are measured in degrees, minutes and seconds. For example, the exact coordinates of Rio de Janeiro (Brazil) are 22° 54′ 10″ S, 43° 12′ 27″ W.
- There are places located at points where no parallel or meridian has been marked. In these cases, we make an **approximation**. For example, Rio de Janeiro is at approximately 22° S, 43° W.
- Approximations are allowed in a school activity, but not in reality. Each degree of error on a map corresponds to more than 100 km in reality.

Your turn

- **Look at** the map and **find** Quito, London, Rome, Kinshasa and St Petersburg. **Note** whether they are in the Northern or Southern Hemisphere and in the Western or Eastern Hemisphere. **Give** their approximate geographic coordinates.
- **Find** the ship on the map. The ship has broken down. **Imagine** you are the captain of the ship. **Write** the message you would send to the rescue teams to give them your position.
- **Find** the point with coordinates 40° N, 90° W on the map. **Check** the world map in your atlas and identify the country these coordinates refer to.

KEY QUESTIONS

- **Define** *latitude* and *longitude* and **explain** which reference points are used in each case.
- **Explain** what geographic coordinates are. **Give examples** of situations when it would be necessary to understand geographic coordinates.

15. Cape of Good Hope (South Africa)

5. Geographic coordinates: the exact position of a point

What are longitude and latitude?

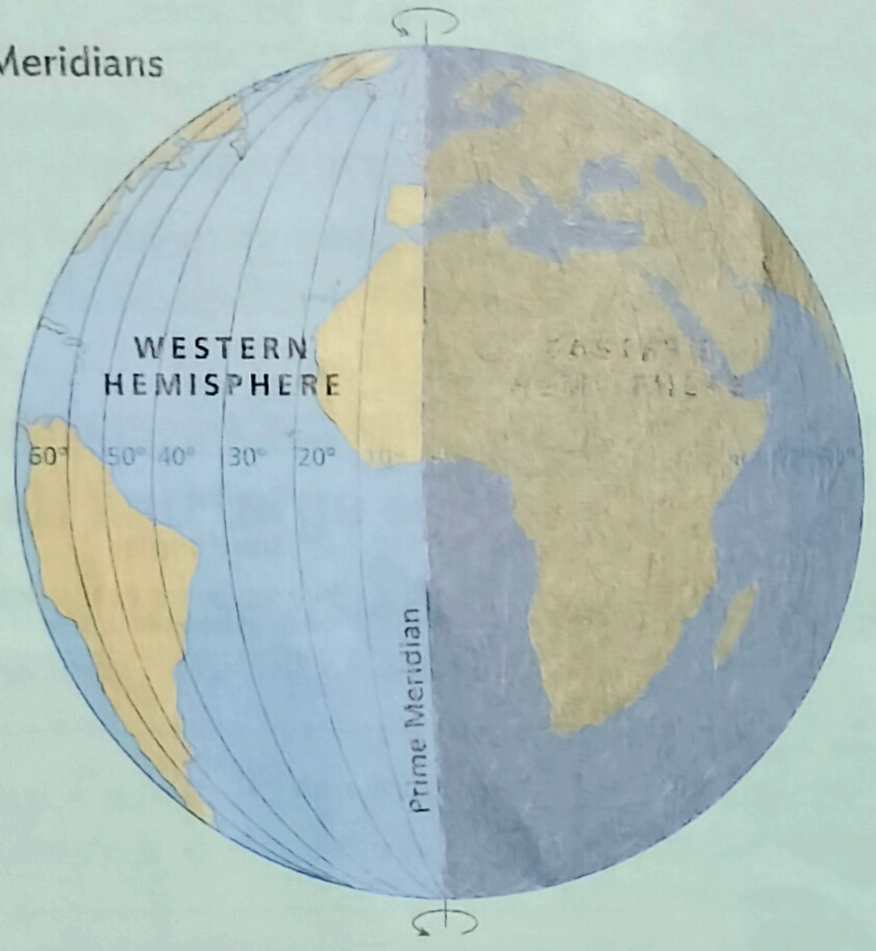
Longitude and latitude lines are a network of **imaginary lines** that were invented so that any point on Earth can be located accurately.

The number of possible longitude and latitude lines is infinite. However, usually only the main ones are drawn on maps and globes.

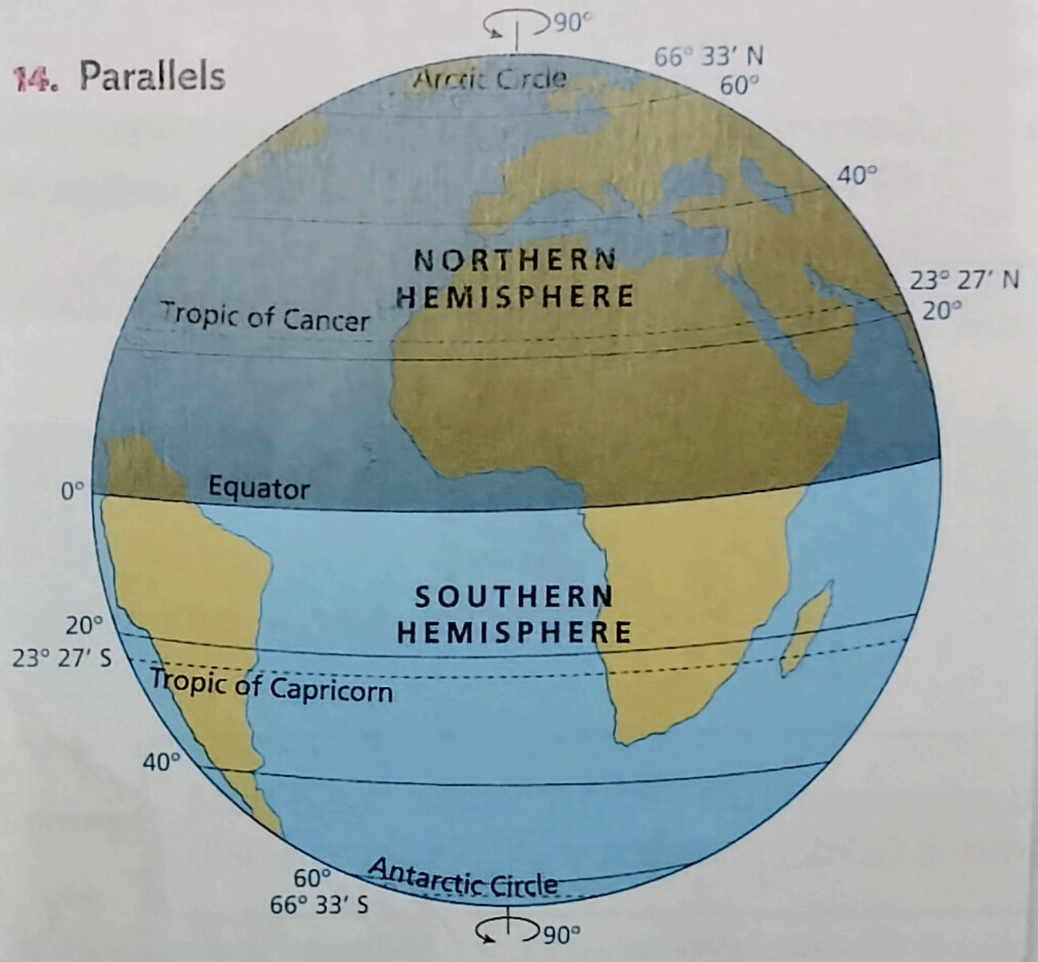
- The lines of longitude, or **meridians**, are imaginary lines joining the poles. They run from north to south. (13)
- The reference meridian is the zero meridian (0°) or **Prime Meridian** (also known as the **Greenwich Meridian**). This line divides the Earth into the **Eastern Hemisphere** (east of the Prime Meridian) and the **Western Hemisphere** (west of the Prime Meridian).

- The lines of latitude, or **parallels**, are imaginary circles perpendicular to the meridians. They run from east to west. (14)
- The reference line of latitude is the **Equator** (0°). It divides the Earth into the **Northern Hemisphere** (north of the Equator) and the **Southern Hemisphere** (south of the Equator). Other important parallels are the **Arctic Circle**, the **Tropic of Cancer**, the **Tropic of Capricorn** and the **Antarctic Circle**.

13. Meridians



14. Parallels



Geographic coordinates

Geographic coordinates are the latitude and longitude of a location. They indicate the exact position of any point on the planet.

- **Latitude** is the distance from any parallel of the Earth to the Equator. It can be **north (N)** or **south (S)**, depending on whether that place is in the Northern or Southern Hemisphere. Its value ranges from 0° (on the Equator) to 90° (at the poles).
- **Longitude** is the distance from any meridian to the Prime Meridian. It can be **east (E)** or **west (W)**, depending on whether that location is in the Eastern or Western Hemisphere. Its value ranges from 0° (at the Prime Meridian) to 180° (opposite the Prime Meridian).

DIGITAL TASK

- Go to www.gps-coordinates.net and find out the geographic coordinates for where you live.

WORK WITH THE IMAGE

- Look at the photo and give the coordinates of the Cape of Good Hope.

1. What is planet Earth like?

A planet in the solar system

Our knowledge of the universe has improved greatly over time. This is a result of the progress of astronomy and the use of sophisticated instruments, such as telescopes and artificial satellites.

The **universe** is made up of **galaxies**, which are clusters of millions of stars. Many stars have planets and other natural objects that revolve around them and form **planetary systems**. This is the case in our own solar system.

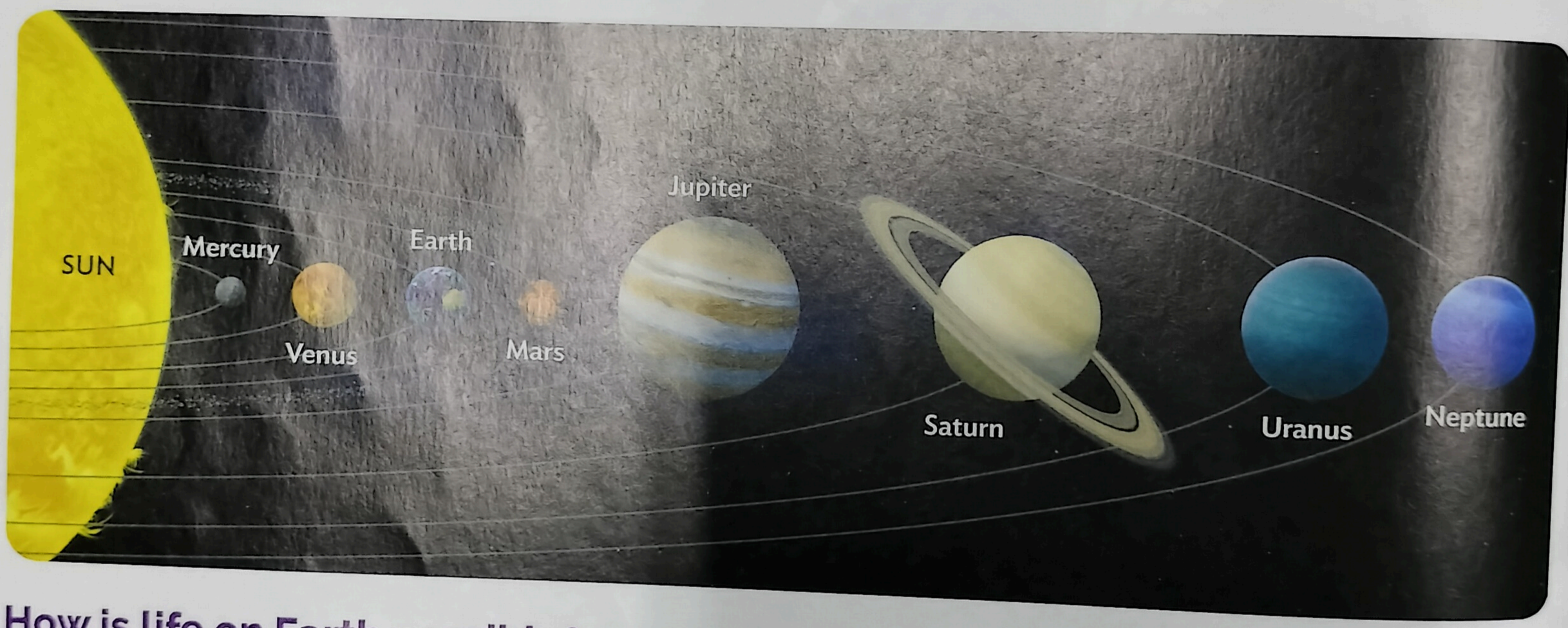
The **solar system** is made up of: (2)

- A star (the Sun).
- Eight planets.
- Many satellites and other natural objects (dwarf planets, asteroids, comets, etc.). The Moon is the Earth's only satellite.

1. Planet Earth seen from space

WORK WITH THE IMAGES

- List the planets of our solar system and state where Earth is with respect to the Sun.
- Look at the biosphere. (3) Below which altitude do we find the greatest concentration of living things? What is the lower limit for life?
- List the layers of the geosphere (4) and indicate the thickness of each layer. Name one more characteristic of each layer.



2. The solar system

How is life on Earth possible?

Earth has a number of conditions that make it the only known planet on which life exists. (1)

Distance from the Sun

The distance of the Earth from the Sun makes the temperature of the Earth's surface moderate. If the Earth were closer or further away from the Sun, life would be impossible because it would be too hot or too cold.

Atmosphere

This gaseous layer around the Earth regulates the planet's temperature: it prevents Earth from getting too hot during the day and too cold at night. The atmosphere also contains gases that are essential for living things.

Water

Almost three quarters of the surface of planet Earth is covered by water. This water is mostly in liquid form.

Many organisms live in water. Furthermore, water is essential for the survival of all living things

3. How we represent the Earth

Globes and maps

The shape of the Earth is a geoid. This means that it is not a perfect sphere: it is flatter at the poles. It is best represented by a **globe**, which shows the shapes, distances and sizes of the continents without distortion. (8)

However, a globe has several disadvantages: it is not easily transportable; we cannot see small details; and it does not allow us to observe the entire surface of the planet at once.

For these reasons it is most common to represent the Earth on a map. Maps are flat representations of the Earth's surface that are drawn to scale. There are different types of maps:

- **Topographic maps** contain information about the physical environment (rivers, relief, etc.) and human elements (settlements, farmland, etc.).
- **Thematic maps** provide information on specific aspects (physical, political, etc.) and their distribution over the territory. (11)

a. Globe

How do we represent a sphere on a map?

Mapmaking is very difficult because the Earth has a curved surface and maps are flat. To solve this problem, **cartographic projections** were invented. They are a system that allows the points on the sphere to be transferred to a map.

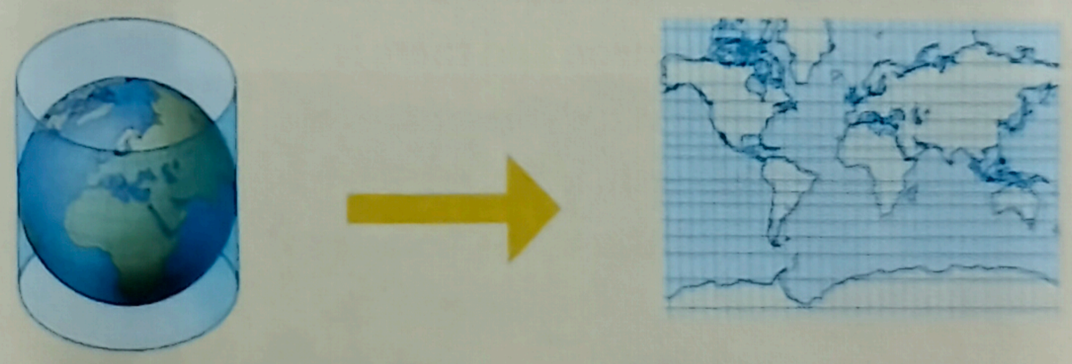
There are different types of projections and each one represents some areas of the Earth better than others. However, each type of projection distorts shape and size in some way because our planet is not flat.

KEY QUESTIONS

- Compare and explain the advantages and disadvantages of globes and maps.
- Look at your atlas and give examples of different thematic maps. Describe what each type of thematic map looks like.

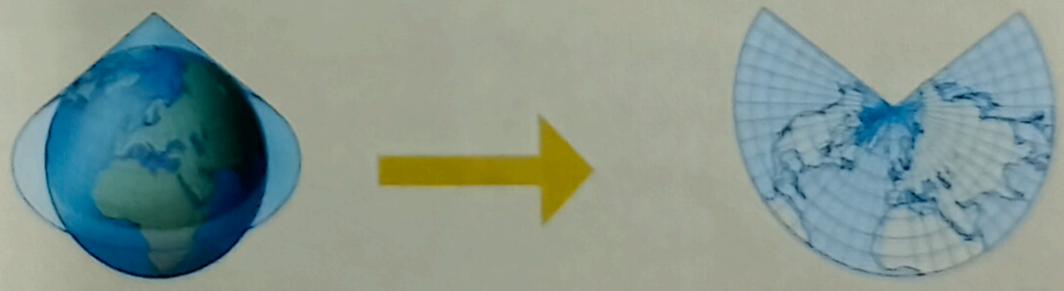
Cylindrical projection

This is obtained by projecting the surface of the globe onto a cylinder. It is the projection that best represents the areas between the tropics. (9 and 10)



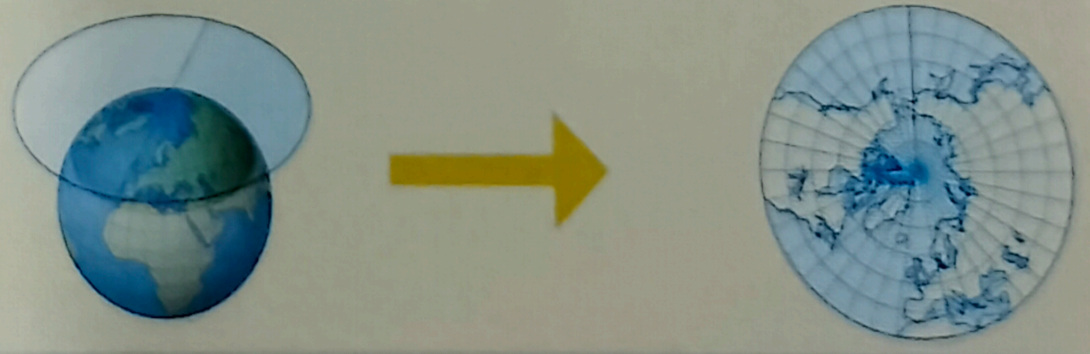
Conical projection

This is obtained by projecting the surface of the globe onto a cone. It is the projection that best represents the areas between the tropics and the polar circles.



Azimuthal projection

This is obtained by projecting the surface of the sphere onto a plane at right angles to one of the poles. It is the projection that best represents the polar zones. (11)



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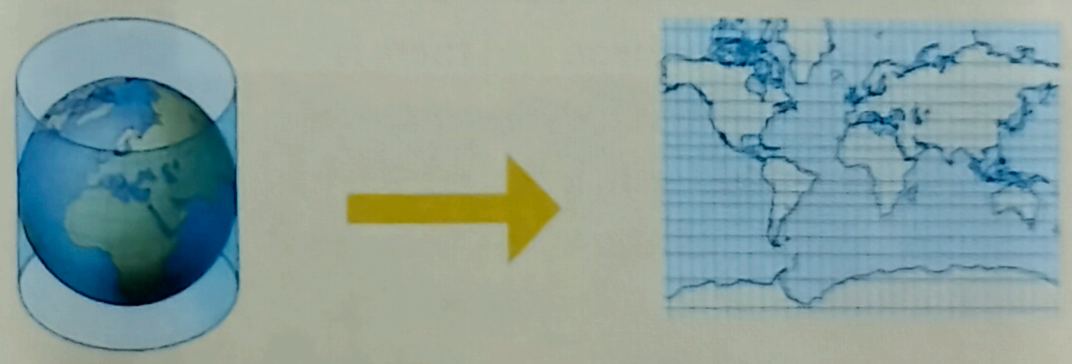

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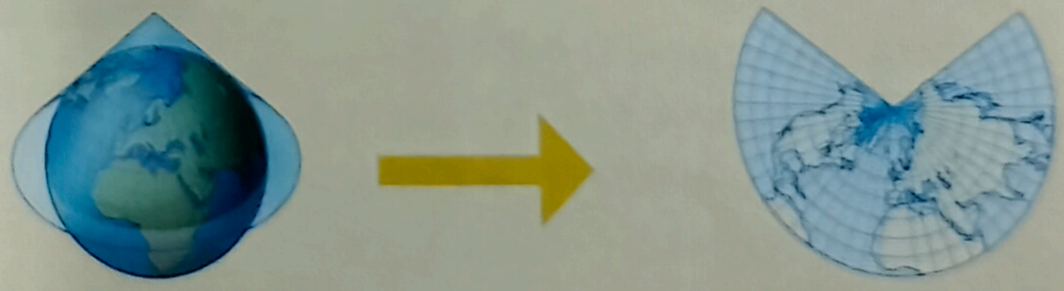

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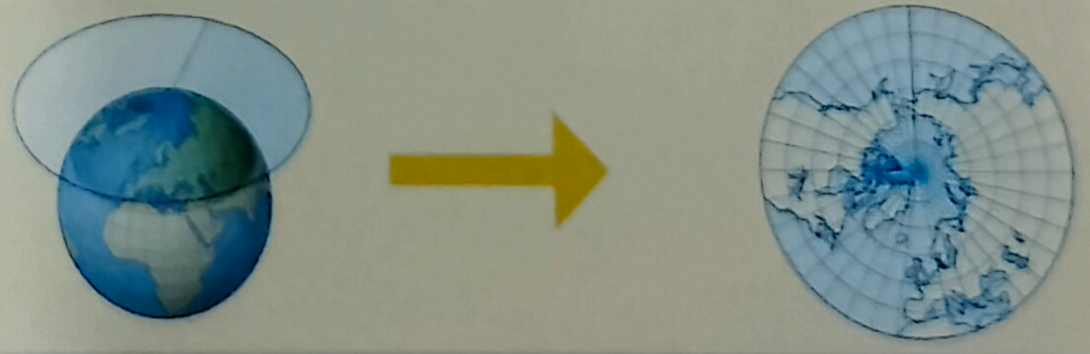

The seasons of the year

When it is summer in one hemisphere, it is winter in the other hemisphere. When it is spring in one hemisphere, it is autumn in the opposite hemisphere.

- In **summer**, one of the two hemispheres receives more direct sunlight. At the same time, it is **winter** in the other hemisphere, because the Sun's rays are less intense.
- During **spring** and **autumn**, the Sun's rays strike the two hemispheres in a similar way.

The dates of the solstices and equinoxes mark the changes in seasons.

- **Solstices:** days that mark the beginning of winter and summer. The solstices take place around the 21st December and the 21st June. At those times, the Sun's rays are perpendicular to one of the tropics, which receives much more sunlight than the other tropic.
- **Equinoxes:** days that mark the beginning of autumn and spring. They take place around the 23rd September and the 21st March. On those days the Sun's rays are perpendicular to the Equator and day and night both last 12 hours in each hemisphere.

  The only exception is at the poles: the day lasts for six months and the night for six months.

KEY QUESTIONS

- Describe the two movements of the Earth.
- List and explain the effects of the Earth's rotation and revolution on our lives.
- Define *leap year* and explain why it occurs. When is the next leap year?

COMMUNICATION

- Do you think you could easily adapt to living in a place with six months of day and six months of night? Discuss with your partner.

EXPLORE

The midnight sun

In areas north of the Arctic Circle, around the time of the summer solstice, the Sun can be seen 24 hours a day. This is because the Sun does not go below the horizon and there is constant twilight. This natural phenomenon is known as the **midnight sun**. It is caused by the tilt of the Earth's axis relative to the horizontal plane of the Earth's orbit, which exposes the North Pole to the Sun. (7)

In the Southern Hemisphere, the winter solstice occurs on the same date. In areas close to the South Pole, the opposite phenomenon occurs: the so-called **polar night**, which is the absence of sunlight for 24 hours a day.

Around the time of the winter solstice in the Northern Hemisphere, the situation is reversed: the polar night arrives in the Northern Hemisphere and the midnight sun in the Southern Hemisphere.

7. Lofoten (Norway)

Investigate

- Find out where in Norway Lofoten is located.
- Look at your atlas. If you wanted to see the midnight sun, which countries could you travel to?
- Investigate the effects that the midnight sun can have on sleep. How do you think it would affect you?