

# 5 The gaseous part of the Earth



 In this unit you will find out the answers to these questions:

- How was the **atmosphere** formed? Why is it necessary for our planet?
- What is air and what **properties** does it have?
- Why is air important for living things?
- What are the main atmospheric phenomena?
- What affects atmospheric **weather**?
- What's the difference between weather and **climate**?
- What instruments **measure** the temperature, pressure, **speed**, and humidity of air?

Before you start, check you understand the meaning of the words in blue.

## KEY WORDS

**atmosphere:** the mixture of gases that surrounds the Earth

**properties:** characteristics

**weather:** the temperature, sunshine, rain, and wind affecting an area

**climate:** the type of weather that a country or region has

**measure:** to find the size, length, or amount of something

**speed:** how fast something moves

## KEY WORDS

**photosynthesis:** when green plants use sunlight to synthesise nutrients from carbon dioxide and water, and produce oxygen

**combustion:** burning

**respiration:** breathing

**evaporation:** when a liquid changes into a gas

**transpiration:** loss of water vapour by plants into the atmosphere

# 1 The Earth's atmosphere: composition, structure and function

When the Earth first formed, the atmosphere was composed of the following:

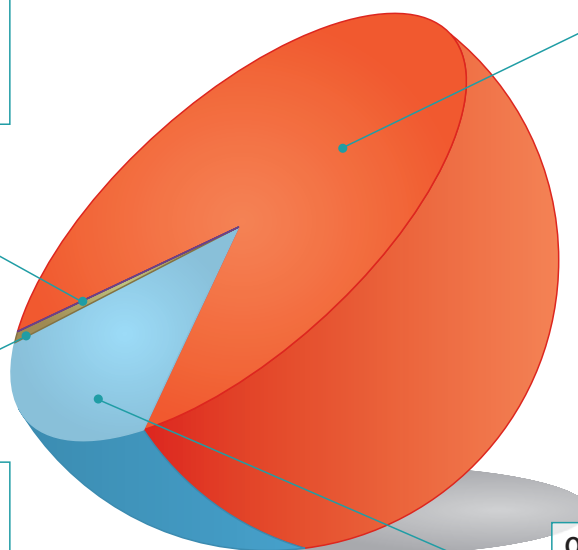
- dust clouds
- gases
- water vapour from volcanic eruptions.

Later, the atmosphere also included oxygen from **photosynthesis**.

The Earth's atmosphere is now a mixture of gases called **air**.

**Carbon dioxide (CO<sub>2</sub>), 0.03 %:** this gas has no colour or smell, and is soluble in water. It is produced by plant and animal respiration and the combustion of certain substances. It is essential for photosynthesis.

**Nitrogen (N<sub>2</sub>), 78 %:** this gas has no colour, no smell, and no taste.



**Water vapour (H<sub>2</sub>O) and other gases, 0.97 %:** this comes from the **evaporation** of oceans, lakes, and rivers and also from plant **transpiration**. **Ozone (O<sub>3</sub>):** electrical storms and the interaction of the sun's ultraviolet rays with oxygen produce O<sub>3</sub>.

**Oxygen (O<sub>2</sub>), 21 %:** plants produce O<sub>2</sub> during photosynthesis. It is in the air and water. It is necessary for **combustion** and **respiration**.

Nowadays, the air we breathe is composed of:

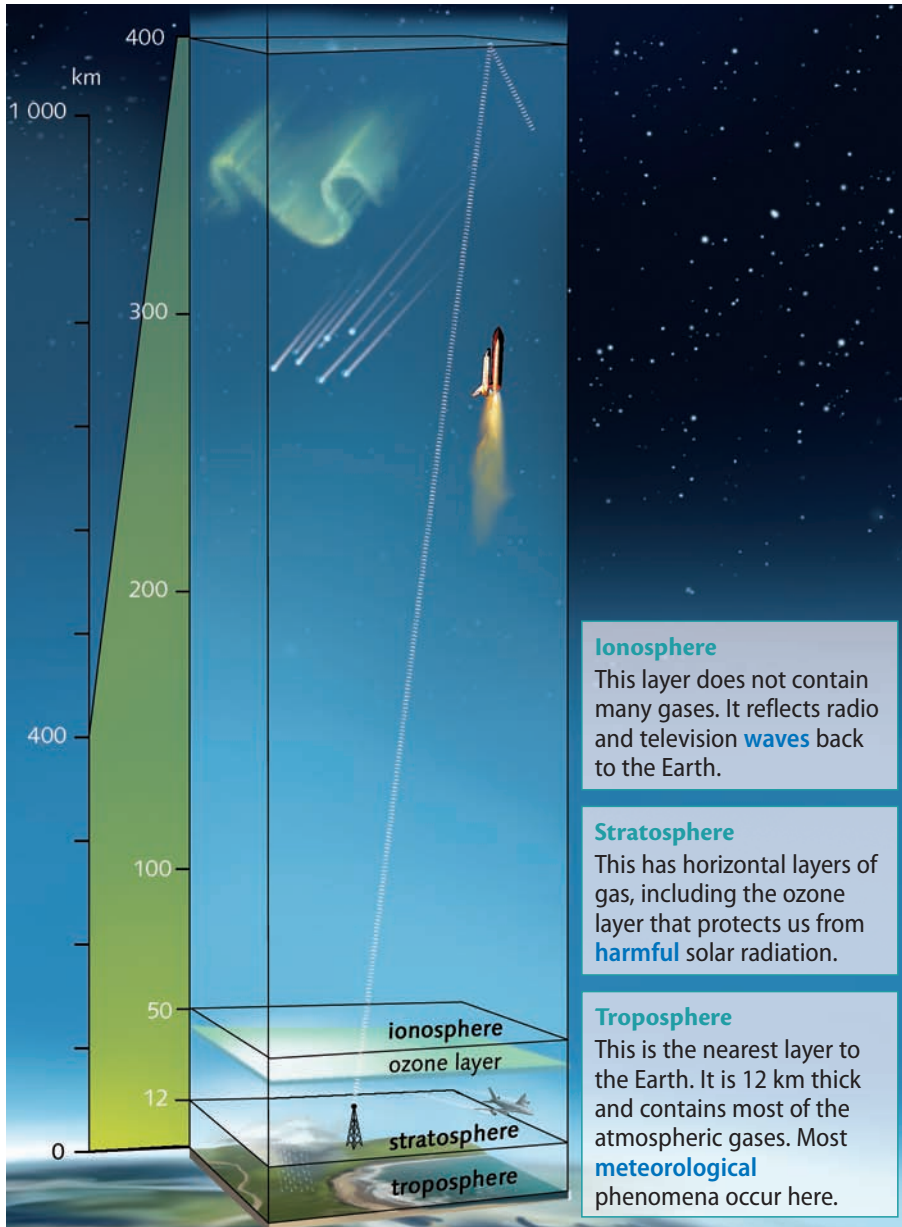
- the original natural components
- additional gases and smoke from industry, cars, heating etc.

Air is also present in the ground, and some gases are dissolved in water.

## Activities

- 1 Listen and repeat the names of the gases.
- 2 Listen again and write the symbols for the gases in your exercise book.
- 3 What differences are there between the original composition of the atmosphere and its composition today? Write them down in your exercise book.

The atmosphere has three main layers:



The layers of the atmosphere. This picture is not drawn to scale. The correct **scale** is on the left of the picture.

## 1.1. The atmosphere regulates temperature

During the day:

- The Earth's surface absorbs some **solar radiation** and **heats up**.
- The warm surface heats the nearest layers of air.
- The radiation that is not absorbed by the ground is reflected and escapes from the atmosphere.
- Not all the excess radiation reaches outer space. Carbon dioxide and water vapour reflect some back to the Earth's surface.
- The Earth's surface heats up again.

Atmospheric **water vapour** and **carbon dioxide** allow direct solar radiation to pass through, but they reflect surface radiation back to the Earth.

### KEY WORDS

**waves:** the way in which some types of energy travel

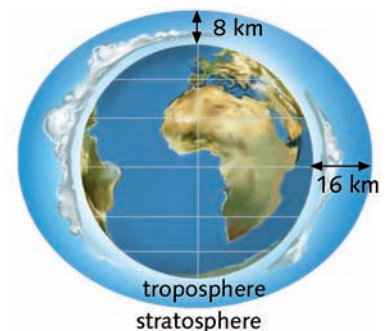
**harmful:** dangerous

**meteorological:** relating to weather conditions

**scale:** the relationship between the size of a map or drawing and the real size of the item it represents

**solar radiation:** energy from the sun

**heat up:** become warmer



The troposphere is not as thick at the North and South Pole as at the Equator.



## KEY WORDS

**average:** the sum of a number of quantities divided by their number, e.g. for 2, 3, and 7, the average is 4:  
 $2 + 3 + 7 = 12$   
 $12 \div 3 = 4$

**unequal:** not the same

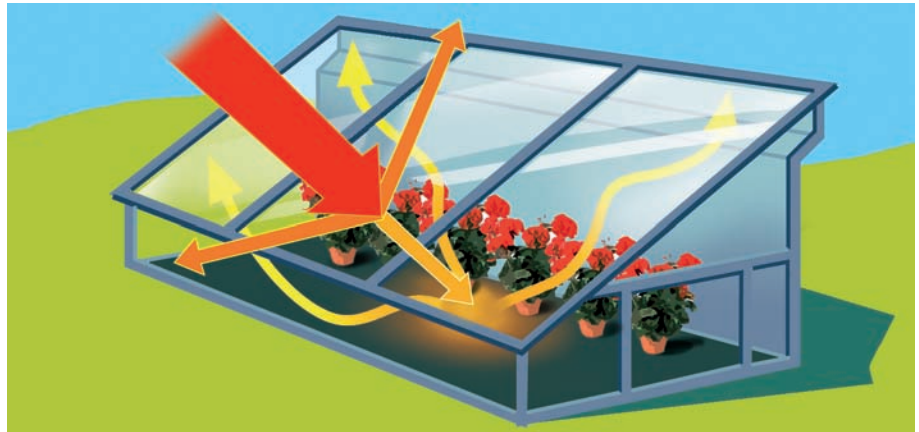
**latitude:** the distance north or south of the Equator, measured in degrees

**sun's rays:** straight, narrow beams of light from the sun

### During the night:

- The atmosphere stops the surface heat escaping into space. The Earth's **average** temperature is  $15^{\circ}\text{C}$  because it retains heat. This means that the lower part of the atmosphere is heated from below. The temperature in the troposphere decreases the higher you go — around  $5^{\circ}\text{C}$  per 1 000 m.

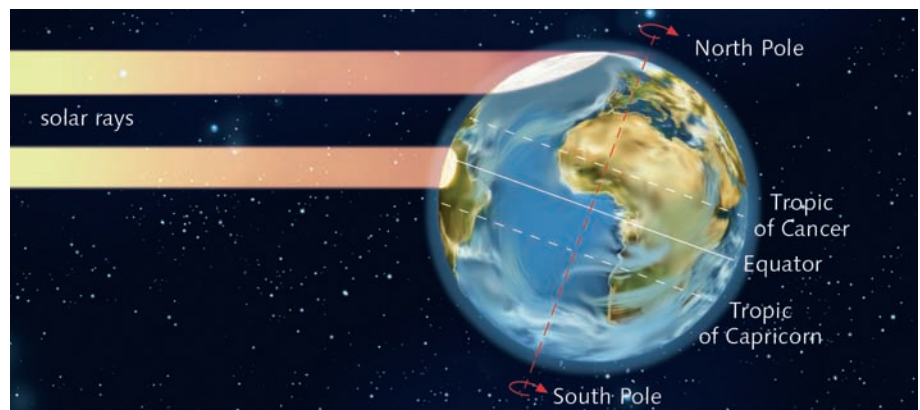
**Water vapour** and **carbon dioxide** retain heat like the glass in a greenhouse. This causes the **greenhouse effect**. Without a natural greenhouse effect the Earth's average temperature would be  $-18^{\circ}\text{C}$ .




The **greenhouse effect**. The glass allows the sun's radiation to enter. It does not release the radiation reflected from the ground inside.

## 1.2. Unequal warming of the planet

- The average temperature of the Earth is  $15^{\circ}\text{C}$ , but the temperature varies depending on the **latitude**.
- The Equator is warmer because the **sun's rays** hit the ground at  $90^{\circ}$ .
- Towards the North and South Poles the sun's rays become more inclined so there is less warmth and also lower air temperatures.
- The temperature of the atmosphere also varies depending on the latitude.
- Air is thicker at the North and South Pole: the sun's rays travel through more air so there is more heat loss.
- The Equator is warmer because the sun's rays affect a smaller surface area than at other latitudes.



# Activities

- 4  Copy the words below into your exercise book. Then listen, repeat, and underline the stressed syllables.


atmosphere

photosynthesis

evaporation

combustion

transpiration

- 5  Say these figures. Then listen and check: 5 °C, 18 °C, 1 000 m, 12 km.

- 6 In your exercise book, write the measurements below out in words. Use the following terms: *kilometres, hundred, degrees, minus, thousand, centigrade, metres.*

- a) 2 300 m
- b) 308 km
- c) -16 °C
- d) 40 °C

- 7 In your exercise book, match the words with their opposites. Chose three of the words and write a sentence using each word.

harmful

horizontal

nearest


reflect

farthest

absorb

safe

vertical

- 8  Copy and complete the sentences with the correct words in your exercise book. Listen and check.

- a) The ionosphere *reflects/absorbs* \_\_\_\_\_ radio waves back to Earth.
- b) The stratosphere contains *horizontal/vertical* \_\_\_\_\_ layers of gas.
- c) The ozone layer *retains/protects* \_\_\_\_\_ us from harmful solar radiation.
- d) The layer *furthest/nearest* \_\_\_\_\_ to the Earth is the troposphere.

- 9 Describe one of the layers of the atmosphere to your partner. Which layer is it?

**Example:**

A: *This layer contains the ozone layer.*

B: *It's the stratosphere.*

- 10 Discuss these questions in pairs and write the answers in your exercise book.

- a) How does the ozone layer help life to exist?
- b) Which gases produce the greenhouse effect? Why is it important?
- c) Would the Earth's temperature be different if there were no natural greenhouse effect? In what way?

- 11 Do the following occur during the day or during the night?

- a) Solar radiation heats the Earth.
- b) There is no solar radiation.
- c) The warm Earth heats the air.

- 12 Choose the correct word. Write out the sentences in your exercise book.

- a) The sun's rays are *more/less* \_\_\_\_\_ inclined at the North or South Pole than they are at the Equator.
- b) At the North and South Poles air is *thicker/thinner* \_\_\_\_\_ than at the Equator.
- c) Areas nearer the Equator are *warmer/colder* \_\_\_\_\_ than areas nearer the North or South Pole.
- d) At the poles there is *more/less* \_\_\_\_\_ heat loss.

- 13 Look at the diagram. Why is it summer in one hemisphere but winter in the other?



- 14 Find out the industrial and therapeutic uses for nitrogen and oxygen.

- 15 Study the key words in Section 1 for two minutes. Then take turns to test your partner. Test each other in one of the following ways:

- 1. A says the word in English. B says the word in Spanish.
- 2. A says the word in English. B gives a definition in English or in Spanish.

- 16 Choose the correct word.

- a) Air *is/isn't* \_\_\_\_\_ a homogenous mixture of gases.
- b) Oxygen *is/isn't* \_\_\_\_\_ produced during photosynthesis.
- c) Air *is/isn't* \_\_\_\_\_ soluble in water.
- d) Additional gases *are/aren't* \_\_\_\_\_ found in the atmosphere today.
- e) During the day excess radiation *is/isn't* \_\_\_\_\_ reflected back into the atmosphere.
- f) During the night heat *is/isn't* \_\_\_\_\_ retained by the Earth.

## KEY WORDS

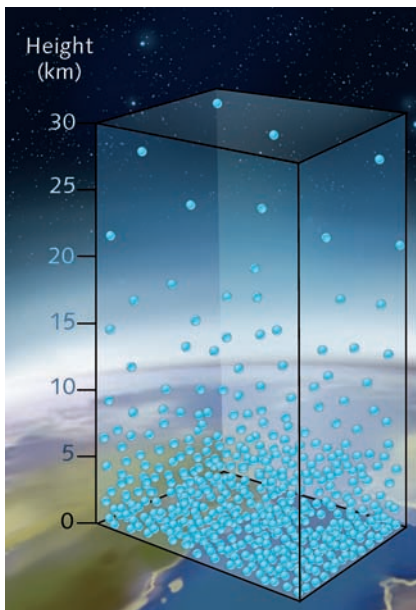
**matter:** the material that everything in the universe is made of

**mass:** the amount of material in something

**weight:** how heavy something is

**magnitude:** force

**particle:** a very small piece of something



More than half of all air is in the first five kilometres of the atmosphere.

## 2 Atmospheric pressure and humidity

Air is **matter**: it has **mass** and **weight**.

■ **atmospheric pressure** = the weight of the atmosphere on the Earth

Everything on Earth is subject to atmospheric pressure. We do not notice atmospheric pressure because:

- we have adapted to it
- pressure is equal in all directions

Pressure is a **magnitude**.

The international unit for pressure is the **pascal** (Pa). When we refer to atmospheric pressure we normally use the **atmosphere (atm)** or the **millibar (mb)**.

$$1 \text{ atm} = 1\,013 \text{ hPa} = 1\,013 \text{ mb}$$

### 2.1. Atmospheric pressure varies with altitude

- The atmosphere is a mixture of compressible gases.
- The lower layers support the weight of the upper layers. The gases here are compressed and denser.
- There are fewer layers above us, so the pressure decreases. Pressure at the top of a mountain is less than at the beach.

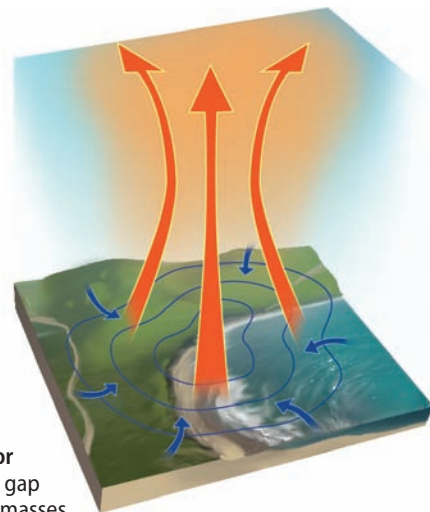
**Normal pressure** is the pressure at sea level (1 atm or 1 013 hPa). Pressure above this is **high pressure**; pressure below this is **low pressure**.

### 2.2. Atmospheric pressure varies with temperature

Unequal atmospheric warming causes horizontal changes in pressure.

The **particles** in warm air rise and separate and leave behind an **area of low pressure**.

Areas of low pressure close to the Earth's surface are called **depressions**. In depressions the pressure decreases towards the centre.

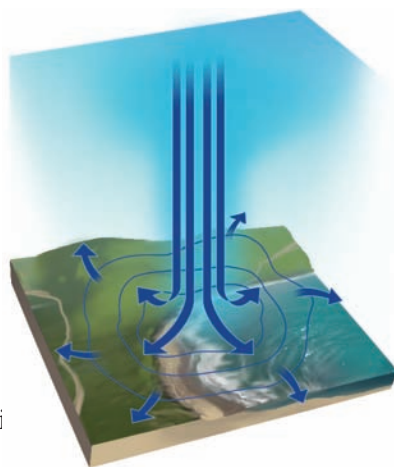


The formation of a low pressure area or depression. The warm air rises, and the gap left behind is filled by neighbouring air masses.

On the other hand, cold air is thicker and heavier and usually falls. This causes the compression of the air mass below it and the appearance of areas called **anticyclones** or **areas of high pressure**.

In anticyclones the pressure increases towards the centre.

Horizontal changes in pressure cause winds because the atmosphere **equalises** the different pressures, which produces air movement.



## KEY WORDS

**equalise:** to make the same

**amount:** quantity

**condensation:** when a gas becomes a liquid

The formation of a high pressure area or anticyclone. The cold air descends and disperses when it reaches the surface.

The air moves from the areas of high pressure to the areas of low pressure, causing **air currents**.

## 2.3. Atmospheric humidity

Air contains water vapour because of:

- **evaporation** from the surface of seas, lakes, and oceans
- **transpiration** from plants

**Humidity** is the **amount** (volume) of water vapour in a specific amount of air.

The amount of water vapour in the air varies depending on:

- the place
- the time of day
- and the temperature.

Hot air usually can contain more water vapour than cold air.

- When air cannot contain any more water vapour we say it is **saturated**.
- The **saturation point** is the maximum amount of water vapour that a unit of air volume can contain without **condensation** occurring.
- Temperature changes affect the saturation point. For example, at 10°C, 1 m<sup>3</sup> of air can contain a maximum of 9.4 g of water vapour.

To find out the amount of water vapour in the air we use two measures: **absolute humidity** and **relative humidity**.

- **Absolute humidity** is the amount of water vapour in 1 m<sup>3</sup> of air at a specific moment. This is expressed in grams.
- **Relative humidity** is the relationship, expressed as a percentage, between the present amount of water vapour in a volume of air and that which it could contain if the volume of air were saturated.

If air is completely dry, then relative humidity is zero. If it is saturated then it is 100% and if it contains half the possible water vapour then relative humidity is 50%.

## KEY WORDS

**region:** area

**far:** a great distance: the opposite of near

**world:** our planet: the Earth

**differentiate:** to tell the difference between things

## 3 Climate

The **climate** of a region is influenced by:

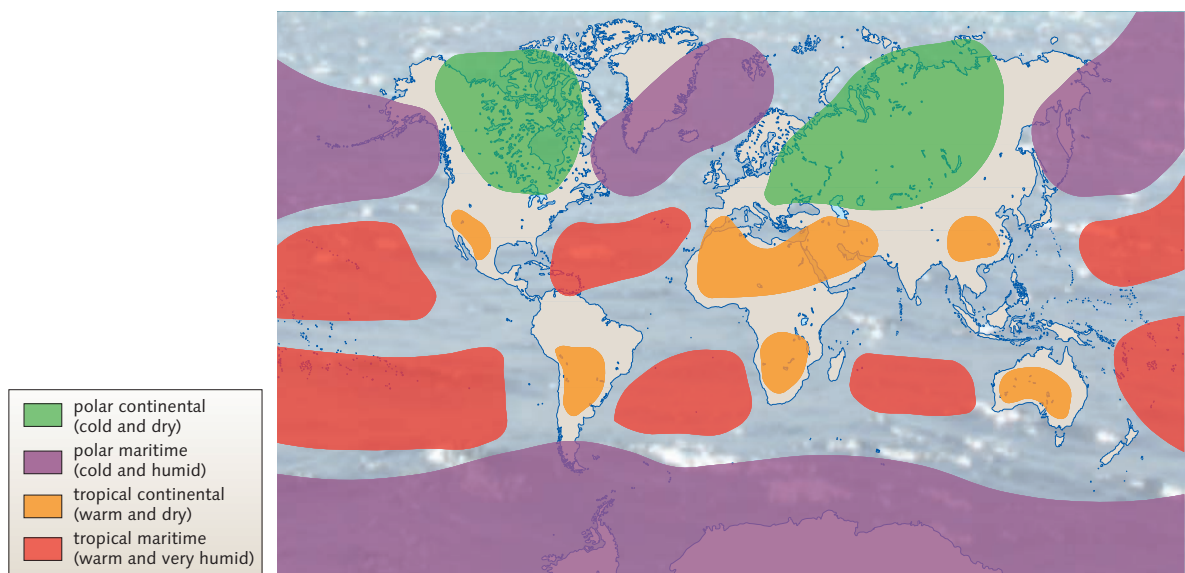
- unequal warming of the planet
- large air masses with different degrees of humidity and temperature and their interaction when they move

**Climate** refers to the main atmospheric phenomena in a specific **region**, which occur every year.

The climate of a region:

- depends on the latitude and how near or **far** it is from the sea
- is expressed in terms of temperature and rainfall

Temperature, humidity, and pressure differences around the **world** mean the troposphere contains large **air masses** that have the characteristics of the area where they were formed. In this way, we can **differentiate** between cold, warm, dry, or humid masses.

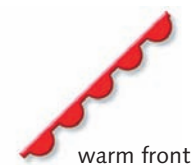
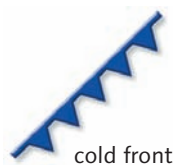


**Air masses.** The two large masses of tropical and polar air in each hemisphere are subdivided into continental and maritime.

These air masses move around. The place where cold air meets warm air is called a **front**.

- A **warm front** occurs when a mass of warm air moves towards a mass of cold air.
- A **cold front** occurs when a mass of cold air moves towards a mass of warm air.

**Cold fronts** are represented by blue lines with triangles on and **warm fronts** by red lines with small semicircles on them.





## Activities

17 Read the text and answer the questions in your exercise book.

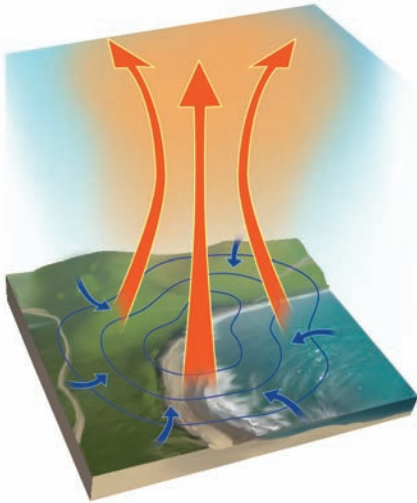
- Why does air have weight and mass?
- What is atmospheric pressure?
- Why does atmospheric pressure decrease when we climb a mountain?

18  Listen and repeat.

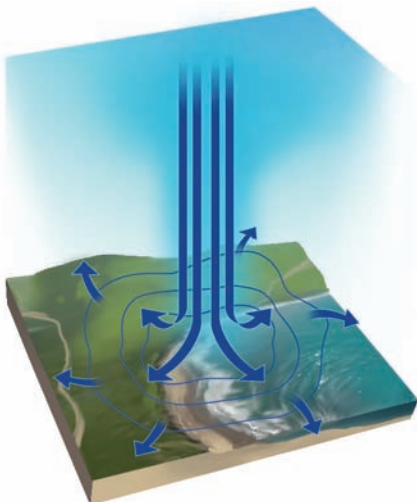
- Atmospheric pressure = the weight of the atmosphere on the Earth
- 1 atm = 1 013 hPa = 1 013 mb

19 What atmospheric phenomena do these diagrams show?

a)



b)



c) How do they form? Write down the steps of the processes in your exercise book.

20 Choose the best definition of climate.

- Climate is the atmospheric conditions in a specific location that occur annually.
- Climate is the different types of weather in a region.

21 In your exercise book, match the columns:

cold air falls

warm air rises

horizontal pressure changes

air moves from high to low pressure areas

air currents

winds

anticyclone

depression

22 The sentences below are incorrect. Replace the words *in italic* with the words in boxes. Write out the correct sentences in your exercise book.

winds

depressions

cold

thicker


high

horizontal

warm

low


- Unequal atmospheric warming causes *vertical* changes in pressure.
- Cold air rises and leaves behind an area of *high* pressure.
- Areas of low pressure close to the Earth's surface are called *anticyclones*.
- Warm air falls because it is *thinner* and heavier.
- Anticyclones are also called areas of *low* pressure.
- Vertical changes in pressure cause *air currents*.

23  Put the words in the correct order to make questions. Then ask and answer the questions with your partner. Listen and check.

- humidity / is / air / What / ?
- in the Earth's / affect / the amount of water / What / atmosphere / factors / ?
- we / use / when / relative humidity / and not absolute humidity / we / talk / Why / about the weather / do / ?

24 Answer the questions in your exercise book.

- What influences a region's climate?
- What does a region's climate depend on? How do we express this?
- Which layer of the atmosphere contains large air masses? What characteristics do they have?
- What is the difference between a cold front and a warm front?

25  Listen and say what type of climate the speaker is describing.

- tropical / polar continental
- tropical / polar continental
- tropical / polar maritime
- tropical / polar maritime

## KEY WORDS

**displace:** to move

**revolve:** turn around

**demolish:** destroy

**charge with:** to absorb and store something

**ash:** the soft grey powder that remains after burning something

**droplet:** a very small drop of liquid

**gravity:** the force that makes things fall to the ground

## 4 Atmospheric phenomena

Atmospheric phenomena occur in the troposphere. They are responsible for changes in the weather. The wind and water vapour in the air can cause these phenomena.

The unequal warming of the Earth's surface causes horizontal differences in pressure; this then causes large air masses to move or **displace**. This displacement produces **winds**, which can be very strong and violent.

### ATMOSPHERIC PHENOMENA CAUSED BY THE WIND

**Hurricanes** are violent tropical storms that form over the ocean. They consist of a central area (the eye), around which clouds and winds **revolve** at great speeds (200 km/h).

**Whirlwinds or dust storms** occur on sunny days in dry open spaces. The Earth heats up; this then heats up the air. The air rises in a spiral and collects sand and dust particles. Whirlwinds only last a few minutes and can be 100 m high.

**Tornadoes** start inside large storm clouds and have an inverted cone shape when they leave the clouds and reach the ground or the sea. These winds can reach speeds of 480 km/h and **demolish** everything in their path.

Water vapour in the atmosphere causes different atmospheric phenomena that are due to condensation or precipitation.

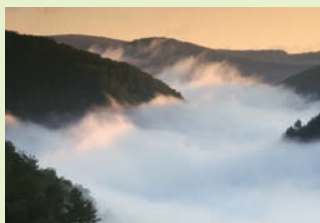
### ATMOSPHERIC PHENOMENA CAUSED BY WATER VAPOUR

#### Due to condensation

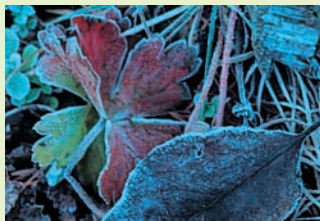
**Clouds** form when air that is **charged with** water vapour rises, cools, and condenses around tiny dust particles, salt, or **ash**.



**Fog** consists of low clouds that form close to the ground. This occurs when the air on the ground cools down but does not go below 0°C.



**Frost** forms when the temperature of the earth's surface is below 0°C and water vapour freezes.

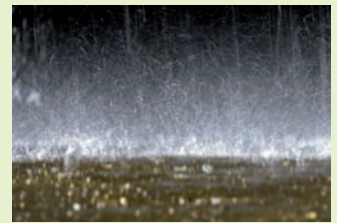


**Dew** is condensed water vapour. This occurs during the night when temperatures drop.



#### Due to precipitation

**Rain** occurs when the water **droplets** in a cloud join together. When they are big enough, **gravity** makes them fall.



**Snow** occurs when the temperature inside a cloud reaches 0°C. The water droplets freeze. They fall from the cloud when they are heavy enough.



**Hail** occurs when there are strong rising air currents inside the cloud which deep freeze the water droplets (-50°C).



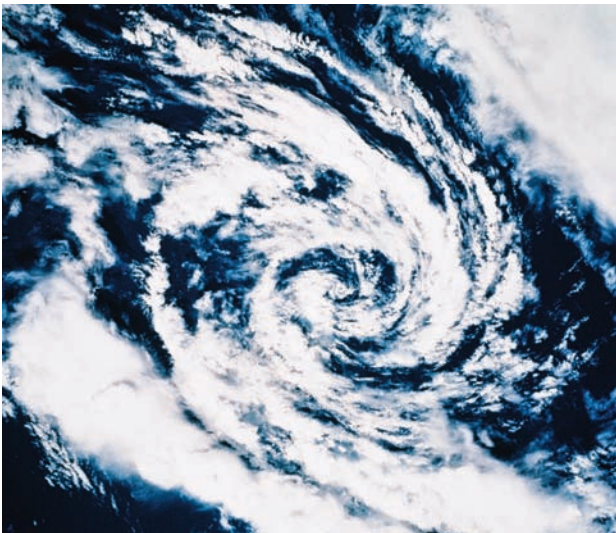
## Activities

**26** Read the descriptions of atmospheric phenomena caused by the wind. In your exercise book, note down which label corresponds to which photograph: *whirlwind or dust storm, tornado, hurricane*.

**a)**



**b)**



**c)**



**27** Where do hurricanes usually form? What characteristics do they have? Write them down in your exercise book.

**28** What is wind? How is it formed? Write notes to describe the process in your exercise book.

**29** In your exercise book, match the verbs to their meaning:

displace

destroy

revolve

move

demolish

turn around

**30** Complete the sentences with the correct verb from Activity 27.

- a)** Tornadoes reach speeds of 480 km/h and \_\_\_\_\_ everything in their way.
- b)** In the eye of a hurricane, clouds and winds \_\_\_\_\_ at speeds of up to 200 km/h.
- c)** Horizontal differences in pressure cause large air masses to \_\_\_\_\_.

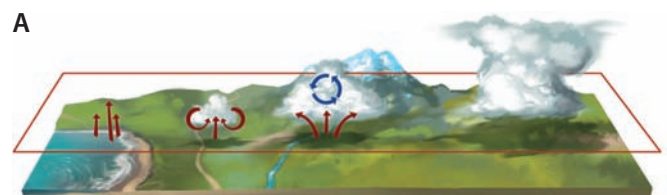
**31** Answer these questions in your exercise book.

- a)** How do clouds form?
- b)** What is the difference between dew and frost?
- c)** What is precipitation? What atmospheric phenomena does it cause?
- d)** Find out how a snowflake forms.
- e)** How does hail form?

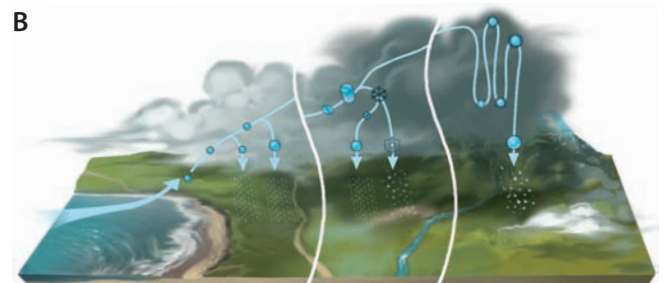
**32** Identify the processes shown in the illustrations and describe them in your exercise book. Include the following words: atmospheric phenomena, evaporation, precipitation. Then describe one of the processes to your partner.

**Example: A:** In A evaporation is occurring over the sea.

**A**



**B**



## KEY WORDS

**vacuum:** a space containing no gas

**needle:** a thin piece of metal that moves and points to numbers on a scale

**scale:** regular marks on a measuring instrument

**funnel:** a thin tube with a wide top, used to pour liquid into a narrow opening

## 5 The weather

**Atmospheric weather** refers to a series of atmospheric phenomena that occur at a specific moment in a specific place.

We describe atmospheric weather in terms of: sun, rain, maximum and minimum temperatures, clouds, winds, and fronts.

These scientific instruments measure data to predict the weather: **thermometer, barometer, rain gauge, hygrometer, and wind gauge.**

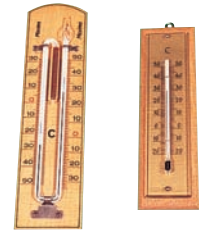
### Thermometer

A **thermometer** measures **atmospheric temperature**. To predict the weather we use a **maximum and minimum thermometer**. This registers the maximum and minimum temperatures in one day.



### Barometer

A **barometer** measures **atmospheric pressure**. The **metal barometer** is the most common. It is a metal tube with a **vacuum** inside. The needle registers the movements produced by changes in air pressure. The **needle** moves around a graduated **scale** (millibars or hectopascals).



### Rain gauge

A **rain gauge (pluviometer)** measures the **amount of water or snow**. It has a container that collects any precipitation in a **funnel**. The scale shows the number of litres per square meter.



### Hygrometer

A **hygrometer** measures atmospheric humidity.

### Weather vane

A weather vane shows the direction of the wind



### Wind gauge

A **wind gauge (anemometer)** shows the **strength of the wind**. The most common wind gauge is the *Robinson*. This has three cups on the end of three arms. The arms are joined to a vertical shaft. The shaft connects to a system of wheels and gears. Speed is shown in km/h.



## Activities

**33** If there is an 80 km/h north wind, what instruments do we use to find out the direction and speed of the wind?

# Activities

34 Look at the graph and answer the questions.

Month	Average temperature (°C)		Total average precipitation (mm)
	Daily minimum	Daily maximum	
Jan	2,6	9,7	37
Feb	3,7	12	35
Mar	5,6	15,7	26
Apr	7,2	17,5	47
May	10,7	21,4	52
Jun	15,1	26,9	25
Jul	18,4	31,2	15
Aug	18,2	30,7	10
Sep	15	26	28
Oct	10,2	19	49
Nov	6	13,4	56
Dec	3,8	10,1	56

- a) What do the following terms refer to:
- minimum temperature
  - average temperature
  - average precipitation
- b) How many months have a daily maximum temperature of over 30 °C?
- c) How many months have a minimum temperature of under 10 °C?
- d) What are the three wettest months? Does this data refer to climate or weather? Why?
- e) Draw a graph to represent average minimum and maximum temperatures. Which month has the largest difference between the maximum and minimum temperature? And the lowest?

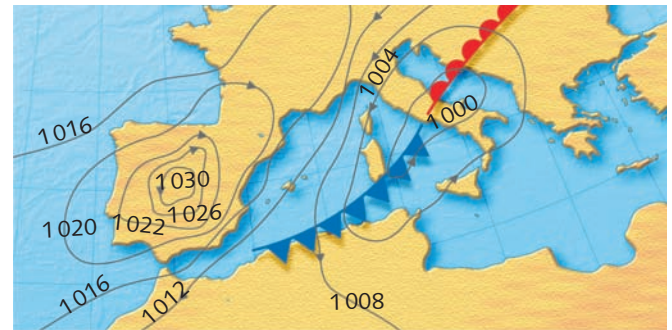
35 Find out the average temperature and precipitation in December and July in your region of the country.

36 Listen and complete the sentences with a missing word from the box.

thermometers    temperatures    weather  
 predict    instruments    fronts    maximum

The series of atmospheric phenomena that occur at a specific moment in a specific place is called atmospheric \_\_\_\_\_. The following terms are used to describe the weather: sun, rain, \_\_\_\_\_ and minimum \_\_\_\_\_, clouds, winds, and \_\_\_\_\_. Scientific \_\_\_\_\_, such as \_\_\_\_\_ or barometers, are used to measure data to the \_\_\_\_\_ weather.

37 Look at the weather map and answer the questions in your exercise book.



- a) Over which country is the depression?
- b) Where would you situate an anticyclone?
- c) Which country is the cold front moving towards? And the warm front?
- d) Will there be clear skies in Spain? Or could it perhaps rain?
- e) Where is the wind stronger? in the Iberian Peninsula or in Italy?

38 Listen and repeat the names of the instruments.

thermometer    barometer    rain gauge  
 hygrometer    weather vane    wind gauge

39 What instrument was used to obtain the measurements in each of these sentences?

- a) There are four litres per square metre.
- b) The maximum temperature today was 35 °C. It was hot!
- c) It was strong today, about 50 km/h.
- d) I think it's coming from the south-west.

40 Complete these sentences with the words in the boxes below.

windy    foggy    front  
 precipitation    clouds

- a) Snow, rain, hail are all types of \_\_\_\_\_.
- b) When it's \_\_\_\_\_, it's difficult to see what's in front of you.
- c) There are dark \_\_\_\_\_ in the sky. I think it's going to rain.
- d) It was so \_\_\_\_\_ last night that a tree in our garden fell down.
- e) There's a cold \_\_\_\_\_ heading for Spain.

## KEY WORDS

**compound:** a substance containing atoms from two or more elements

**raw material:** a natural substance

**foaming agent:** this turns thick liquid into bubbles

**plankton:** microscopic organisms that float in water and feed many animals

## 6 The atmosphere and living things

The atmosphere has certain characteristics that provide our planet with the right environment for life to exist and develop.

All organisms consist of **compounds** containing carbon, hydrogen, nitrogen, and oxygen. The air contains some of the **raw materials** necessary for life: water vapour, carbon dioxide, nitrogen, and oxygen.

- Carbon dioxide is necessary for photosynthesis.
- Oxygen is necessary for respiration.
- Certain components, for example carbon dioxide and water vapour, maintain the optimal temperature and humidity conditions for life to develop, thanks to the greenhouse effect.
- The ozone layer protects living things from harmful ultraviolet radiation from the sun.
- Water vapour condenses and forms clouds, which provide water for living things through rainfall.

### 6.1. Consequences of changes in the composition of the atmosphere

#### The destruction of the ozone layer

The use of CFC gases (**chlorofluorocarbons**) is gradually destroying the ozone layer.

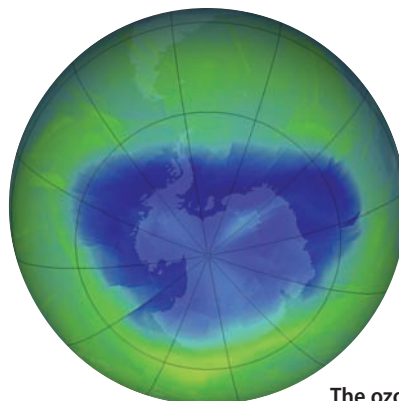
These gases contain chlorine, which is released by ultraviolet radiation. The chlorine then interacts with ozone and transforms it into oxygen.

CFCs are often used in fridges, air conditioning units, aerosols, and as **foaming agents**.

The **destruction of the ozone layer** has serious consequences for living things, including:

- a decrease in the number of algae, **plankton**, and larvae
- an increase in skin cancer, eye irritations, cataracts, and blindness
- a reduction in our defences against allergies and infectious diseases

The destruction of the ozone layer mainly affects **Antarctica**. Every spring a large amount of the ozone disappears, creating the **ozone hole**.



The ozone hole over Antarctica in 2010

## An increase in the greenhouse effect

The increase in the greenhouse effect has two main causes:

- the release of large quantities of carbon dioxide into the atmosphere from the combustion of oil-based fuels and coal in industry, vehicles, and heating.
- **deforestation**: the destruction of large areas of forest, which could have consumed this excess of carbon dioxide through photosynthesis

The direct consequence of an increase of greenhouse gases in the atmosphere is **global warming**: an increase in the global temperature of the planet.

Global warming could have many other consequences:

- The melting of ice masses at the Poles would cause a rise in sea levels. This would flood many coastal areas and destroy cities and agricultural land.
- Salt water would contaminate the freshwater reserves near the sea.
- The increased heat from climate change would increase the rate of evaporation, and this would alter the global pattern of rain and winds.
- **Desertification** would also increase in many areas, while in others there would be torrential rains.
- Many animals and plants would disappear.
- The higher temperatures would result in the spread of many **pests** and tropical **diseases** to temperate regions of the world.

## Air pollution

Human activities alter the composition of the air and introduce possibly harmful gases and particles.

**How we breathe:**

- Air enters our body through our nose and mouth.
- It enters the respiratory system and goes to the lungs where it enters the **alveoli**.
- **Haemoglobin** in the blood collects the oxygen from the alveoli and transports it around the body.
- The alveoli also collect toxic substances in the air, which can damage our respiratory organs, irritate our eyes and skin, and be **poisonous**.

## Activities

41 Why do the following help reduce the amount of CO<sub>2</sub> in the atmosphere? What effect will they have on the greenhouse effect?

- a) Using wind or solar energy.
- b) Using hybrid or electric cars.
- c) A reduction in the amount of heating we use and thermal insulation in houses.

## KEY WORDS

**deforestation**: when the vegetation in an area disappears

**desertification**: when an area becomes a desert

**pest**: an organism that is harmful to crops, farm animals, or humans.

**disease**: illness

**alveoli**: tiny air sacs in the lungs

**haemoglobin**: the red part of the blood that transports oxygen

**poisonous**: toxic

There is more air pollution in cities than in rural areas, so asthma, bronchitis, and lung cancer are more frequent in urban areas.

MAIN AIR POLLUTANTS		
Pollutant	Source	Effects
Carbon Dioxide (CO <sub>2</sub> )	All burning processes	High levels are not dangerous. But the rise of CO <sub>2</sub> in the atmosphere is increasing the greenhouse effect.
Carbon monoxide (CO)	The partial burning of natural gas and coal. The main source of CO is vehicles.	When breathed in, CO combines with haemoglobin in the place of oxygen. So the body's cells receive less oxygen, which can cause death.
Sulfur dioxide (SO <sub>2</sub> )	The burning of compounds that contain sulphur for example coal and petrol. Volcanic eruptions also produce it naturally.	It damages our respiratory organs and irritates our eyes and throats. It also destroys the leaf tissue of plants.
Hydrogen sulfide (H <sub>2</sub> S)	Natural emissions from volcanic eruptions and decomposition of organic matter. Industrial manufacture of cellulose and paint, petrol refineries and waste burning also produce it.	A colourless gas that smells of rotten eggs. It can be toxic in closed spaces.
Nitrogen oxides	Mainly from power stations that burn coal to produce electricity.	It irritates the eyes and affects the lungs. It is fatal in large amounts.
Ozone	The action of the sun's rays transforms pollutants from certain human activities.	When the level of ozone is 1 or 2 parts per million (ppm) it irritates the respiratory tract and causes bronchitis, headaches, and changes to our nervous system. It is also toxic for some plants.
Solid particles (smoke, dust, ash...)	Industrial processes, the burning of fuel, and forest and agricultural fires.	Small particles (less than 10 µm in diameter) irritate the lung tissue and affect the respiratory process.

## Activities

**42** The table shows emissions of atmospheric pollutants by a European country. Look at the table and answer the questions in your exercise book.

POLLUTANTS PRODUCED BY THE BURNING OF FOSSIL FUELS			
Pollutants	Petrol derivatives	Natural gas	Coal
Carbon dioxide	74 500	53 200	95 000
Nitrogen oxides	200	40	210
Sulphur dioxide	510	0,3	1 180
Solid particle	38	3	1 205

Kilograms of pollutant for every 1 055 J of energy released during combustion.


- Do all fossil fuels increase global warming?
- Which of the fuels in the table affects our health more? Which is the most poisonous for the environment? Which is the cleanest?

**43**  Listen and say what pollutant the speaker is describing.


- nitrogen oxides / carbon dioxide
- sulfur dioxide / solid particles
- ozone / hydrogen sulfide
- carbon monoxide / carbon dioxide
- ozone / carbon dioxide
- solid particles / hydrogen sulfide



## Activities

- 44  Copy and complete the table in your exercise book. Listen, check and repeat the words.

verb	noun
	destruction
contaminate	
emit	
	transformation
reduce	
	interaction
deforest	

- 45 Write the sentences in the correct order in your exercise book to explain the destruction of the ozone layer.
- The ozone layer is gradually destroyed.
  - The chlorine then interacts with ozone and transforms into oxygen.
  - In the atmosphere the chlorine in CFCs is released by ultraviolet radiation.
  - Fridges, aerosols, etc. contain CFC gases which are released into the atmosphere.
- 46  Read the text again and answer the questions in your exercise book. Listen and check.
- Why do living things need air to live?
  - What gases cause the destruction of the ozone layer? How?
  - Why is it a problem if saltwater contaminates freshwater reserves?
  - What would cause an increase in the rate of evaporation?
  - What would happen to many animals and plants if global warming continues to increase?
  - What would be the result of higher temperatures in temperate regions of the world?
- 47 Find out what regions are most affected by deforestation and desertification.
- 48 In small groups invent a slogan for one of the following campaigns:
- to reduce deforestation
  - to reduce desertification
  - to reduce air pollution
  - to reduce global warming
- 49 Through which process do atmospheric pollutants reach the cells of our internal organs?

- 50 Look at the photo and read the text. Then answer the questions in your exercise book.

### The Kyoto Protocol



The Kyoto Protocol is an agreement between most of the United Nations countries to reduce greenhouse gas emissions by 5.2% (with respect to the 1990 level) between 2008 and 2012. By 2006, 111 countries had signed the agreement, but the USA and China, two of the countries which produce the most pollution, did not sign it. The European Union agreed to reduce emissions of the six greenhouse gases (e.g. CO<sub>2</sub>) by 8% across all EU countries. This meant that emissions in some countries must be reduced, but in others, such as Spain, they could increase. By 2011, Europe had succeeded in reducing its emissions by more than 8%, but Spain had already exceeded the 15% increase that was agreed for 2008-2012. Globally, the concentration of atmospheric CO<sub>2</sub> is still increasing.

- What can you see in the photo? What is produced there?
  - What is the objective of the Kyoto Protocol?
  - How many countries had signed it by the end of 2006?
  - Which two countries pollute the most?
  - What percentage did the EU agree to reduce greenhouse gas emissions by?
  - Has Spain controlled its emissions sufficiently?
- 51 Unjumble the letters to form words. Then match the word to its definition.

pnltoakn

dectifisaretion

famnoig

anegt

desteatforion

cpunoomd

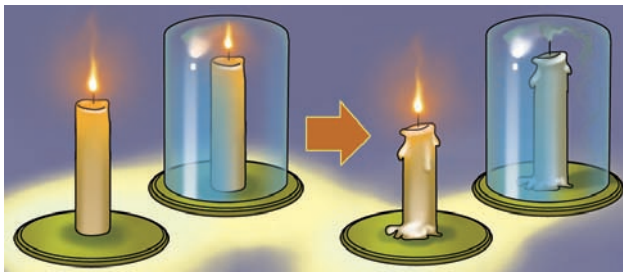
- When the vegetation in an area disappears.
- When an area becomes a desert.
- A substance containing atoms from two or more elements.
- This turns thick liquid into bubbles.
- Microscopic organisms that float in water and feed many animals.

# Revision activities

**1** Find eight words from the unit in the word search. Write them down with definitions in your exercise book.

K	C	N	E	W	W	F	V	A	L	H	I	N
O	P	O	G	R	A	B	S	L	U	F	O	Y
Q	V	V	M	D	U	R	J	R	K	I	N	T
C	F	V	B	B	G	S	R	M	T	C	O	I
L	V	Q	E	T	U	I	S	A	K	U	S	D
H	V	L	J	V	C	S	T	E	O	E	P	I
L	B	S	Q	A	R	I	T	Q	R	M	H	M
C	F	Q	N	Y	P	M	Z	I	U	P	E	U
H	H	E	H	I	X	L	T	K	O	M	R	H
C	X	U	C	V	R	M	G	D	X	N	E	N
K	B	E	F	T	N	A	T	U	L	L	O	P
O	R	O	G	Y	V	R	K	F	Z	P	O	J
P	C	O	N	D	E	N	S	A	T	I	O	N

**2** Look at the diagram below and answer the questions in your exercise book.



- a)** Which gas is consumed when a candle burns?
- b)** Why does the candle inside the jar go out but the one on the outside stays alight?

**3** Work in a group. Discuss the following questions. Then compare your answers with another group.

- a)** How do forests help to reduce carbon dioxide?
- b)** How does a high-pressure area or anticyclone form?
- c)** Why do atmospheric pressure, the amount of oxygen, and temperature decrease the higher up you go?

**4** Which of the following can be observed in high-pressure areas in the northern hemisphere, and which in low-pressure areas?

- a)** The winds turn clockwise.
- b)** Winds revolve around a central point.
- c)** Hot air rises.
- d)** Pressure increases towards the centre.

**5** In your exercise book, match the instruments to what they measure.

Thermometer	Kilometres per hour
Hygrometer	Kilopascals
Wind gauge	Degrees centigrade
Barometer	Percentage of water vapour

**6** The words in *italic* in these sentences are incorrect. In your exercise book, write out the correct sentences.

- a)** Plants use carbon dioxide for *respiration*.
- b)** Living things obtain water through *radiation*.
- c)** All living things use oxygen for *photosynthesis*.
- d)** We are protected from ultraviolet *precipitation* by the ozone layer.

**7** What benefits does the greenhouse effect have for our planet? What damage occurs if it increases?

**8** Electricity is not an atmospheric pollutant but the power stations that use coal or petrol derivatives do cause pollution.

- a)** Which gas enters the atmosphere when we burn coal or petrol?
- b)** How does this gas affect the atmosphere?

## Talking points

**9** Describe a gas to your partner. Your partner guesses what gas you are describing.

**Example:**

**A:** *It has no colour, no taste, and no smell. It forms 78% of the atmosphere.*

**B:** *It's nitrogen.*

**10** Work with a partner. Describe the process of respiration.

**Example:**

**A:** *Firstly, we breathe in air through our nose and mouth.*

**B:** *Then the air...*

**11** Work in a group. We must all help to reduce the emission of pollutants into the atmosphere.

Discuss how we can do this.

**Example:**

**A:** *We can have a shower and not a bath.*

**B:** *We can also use public transport and not cars.*

# Revision activities

## Development of basic competences



Andres and Maria go to the same school. They have just been to a talk by Pedro Duque; the first Spanish astronaut. Pedro first went into space on 29<sup>th</sup> October 1998 aboard the space shuttle "Discovery": he was third flight engineer.

Maria was fascinated by the things that Pedro Duque told them and she is convinced that she will go on holiday to the Moon when she is older. Pedro told them that you can't breathe or hear people speaking on the moon. He also said that you have to wear a special suit to walk on the moon, if not you will disintegrate.

**1** What is there on Earth but not on the moon that lets us live on the surface, hear sounds etc?

The astronaut talked to them about our atmosphere. He said it is a mixture of homogeneous gases and has different layers with different characteristics. He also said that most gases that make up the atmosphere are in the lower levels, so living things and atmospheric phenomena can only exist in the lowest level.

Andres doesn't understand this very well and he asks Maria to help him. He doesn't know in which layer of the atmosphere some of the phenomena he is interested in take place.

**2** In which layer of the atmosphere do the following take place?

- a) A rainbow
- b) The ozone layer
- c) Animal and plant life
- d) Space ship flights within the Earth's orbit
- e) The reflection of radio and TV waves

Pedro also told them that the composition of the atmosphere hasn't always been the same because life has changed it many times over millions of years. For example, today there is a lot of oxygen, thanks to certain life forms e.g. plants, which take in carbon dioxide and produce oxygen.

**3** What is the name of the process by which plants take in carbon dioxide and release oxygen into the atmosphere?

When the students asked Pedro why there was so much time between flight launches into outer space, he told them that for a launch to be successful, the atmospheric conditions, such as temperature, pressure and winds had to be the best possible: so they had to wait until they were.

**4** What instruments measure temperature, atmospheric pressure and wind strength?

On 25<sup>th</sup> October 2003 Pedro Duque, during his second flight to space, wrote in his diary: "The other day I had a pen clipped to my trousers. I knocked against something and I lost my pen. As I noticed this immediately I turned around quickly to pick it up. But it had disappeared! It had flown off somewhere and could have been anywhere: on the floor, on the ceiling, anywhere."



**5** Why did the pen behave so strangely? Why didn't it fall to the floor?

Some of Andres and Maria's classmates asked the astronaut about the greenhouse effect and the hole in the ozone layer. Pedro realized that they were confusing the two phenomena. So he tried to clearly explain the differences between them, the consequences of each and their importance for living things.

**6** What causes the Greenhouse Effect? Would life in Earth be possible without this effect?

**7** Is there any relationship between the Greenhouse Effect and the ozone layer?

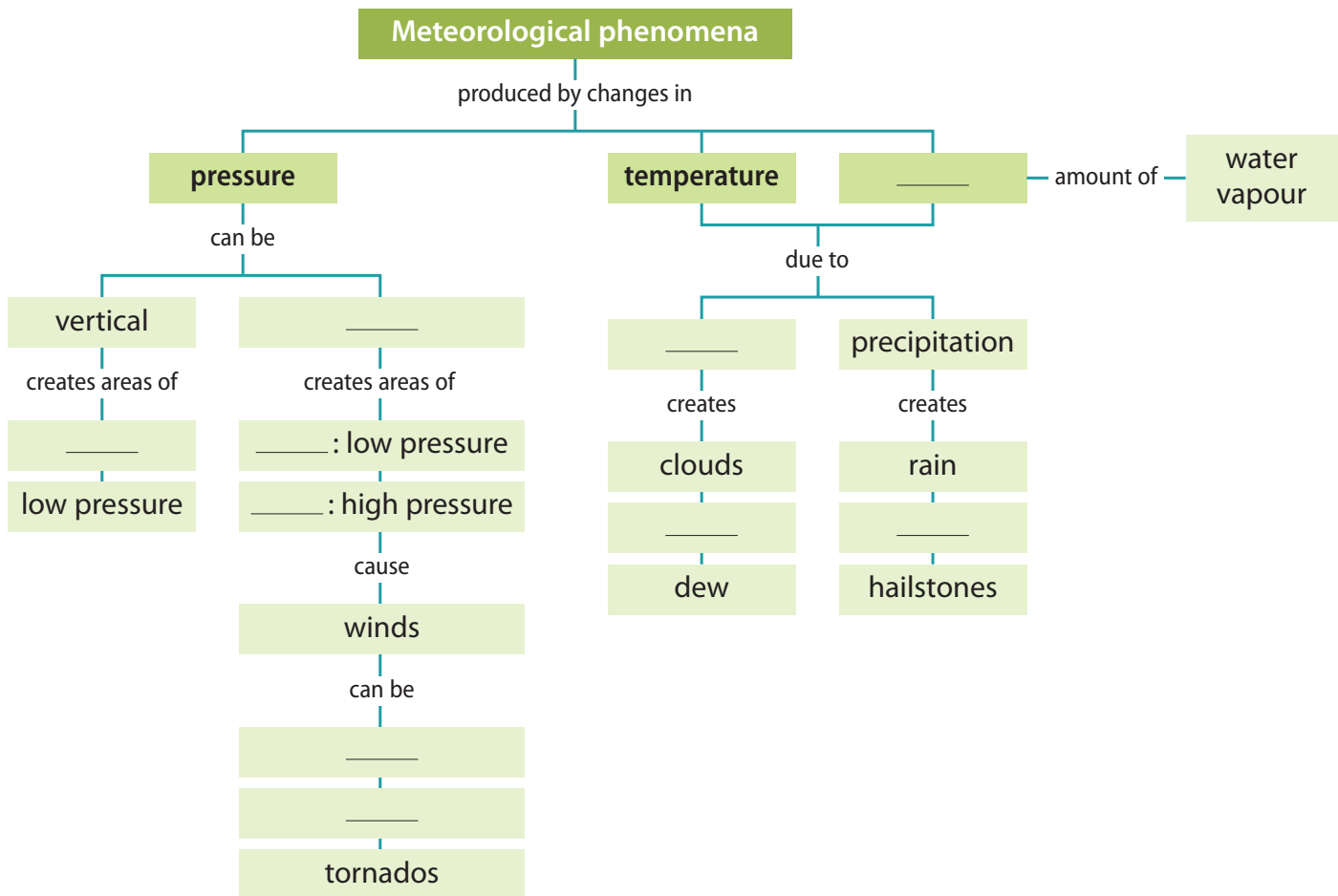
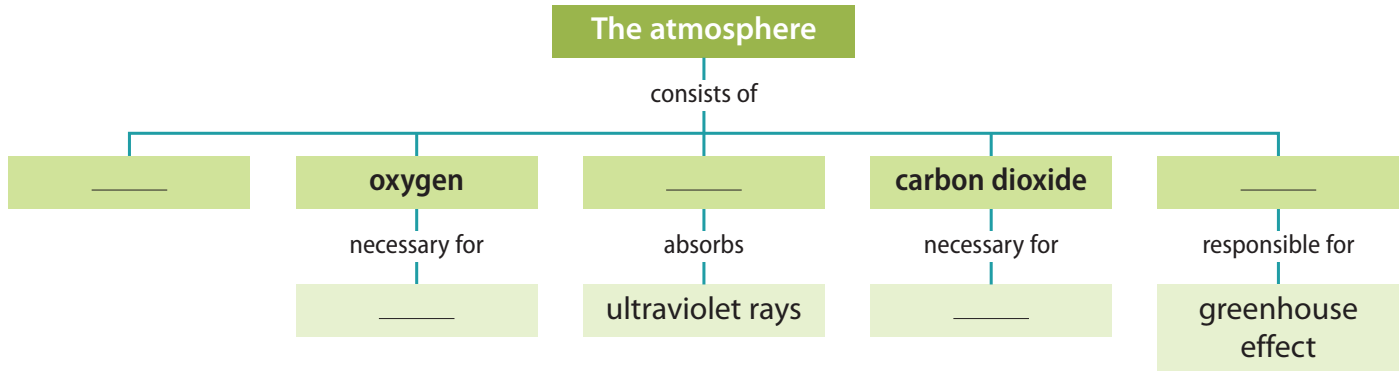
Maria asked him about the weather: she specifically wanted to know if it had rained during his last trip to space. Pedro Duque smiled.

**8** Why did the astronaut smile? Why is Maria's question strange?

# Unit summary

## The Earth's atmosphere

In your exercise book, copy and complete the two charts with the words shown below.



- |                |                  |               |               |                |                 |
|----------------|------------------|---------------|---------------|----------------|-----------------|
| ■ condensation | ■ photosynthesis | ■ fog         | ■ horizontal  | ■ anticyclones | ■ high pressure |
| ■ ozone        | ■ whirlwinds     | ■ nitrogen    | ■ snow        | ■ water vapour |                 |
| ■ hurricanes   | ■ humidity       | ■ depressions | ■ respiration | ■ frost        |                 |