

- 1 Watch. Why does the Sun look bigger than other stars?

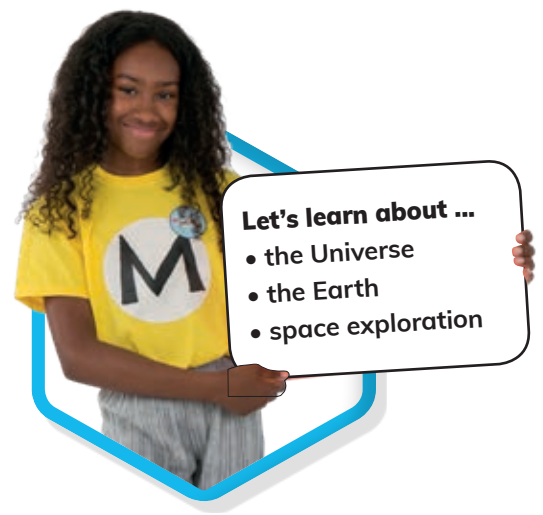
– STEPS

1. Find information.
2. Show your notes to a partner to see if
3. Summarise the information to make it e
4. Add interesting images.
5. Check spelling and grammar.
6. Present your poster at the scienc

-Earth is in Milky Way galaxy
-Galaxy shapes: spiral, elliptical or irregular.

-1961, first astronaut:
Russian - Yuri Gagarin
-1969, American Apollo 11 =
first people on Moon

-Earth rotates on i
-24 time zones are
-24 hours for one r
rotation



- Let's learn about ...**
- the Universe
 - the Earth
 - space exploration

- 2** Look at the information on the computer screens and answer these questions.
- What is the name of our galaxy?
 - Who was the first person in space?
 - How long does one rotation of the Earth take?
 - How long does the Earth take to revolve around the Sun?
- 3** Order the words and write the sentences in your notebook.
- space / in 1961 \ went into \ The first person
 - The Moon / the Earth / around / revolves
 - in 1969 / first visited / Humans / the Moon

Be mindful

Space sounds silent to humans. For some people, complete silence isn't relaxing. They prefer white noise.

Close your eyes and listen. You'll hear silence and then white noise.

Which is most relaxing for you?



What are the lights we see in the night sky?

The Universe is immense and contains billions of different galaxies. Each galaxy contains astronomical objects such as **stars**, planets, satellites, asteroids, **comets** and meteoroids.

1 Have you ever seen this phenomenon in the night sky?



The photo shows part of the Milky Way as it looks from Earth. This is the galaxy that the Earth is in.

Basically, a galaxy is an enormous collection of planets, stars, gas and dust. The forces of gravity hold all the components of a galaxy together.

Astronomers calculate that there are about 100 billion stars in the Milky Way.

2 Read and answer the questions in your notebook.

There are billions of galaxies in the Universe and they can be different shapes: elliptical, spiral or irregular. The Milky Way is a good example of a spiral galaxy.



The Sun is one of the billions of stars in the Milky Way. It's very important for all living things on Earth, and it's the closest star to our planet. However, it's not at the centre of our galaxy. In fact, it's very difficult to see the centre of the Milky Way and scientists are not sure what's there. Many scientists think that there is a black hole at its centre.


- Which star is closest to the Earth?
- What shape is the Milky Way?
- What's at the centre of the Milky Way?

3 Listen to the students talking about black holes. Copy and complete the sentences in your notebook. 002

- The at the centre is so strong that light is trapped inside it.
- Black holes form when very old giant stars .

4  Work with a classmate. Answer the questions.

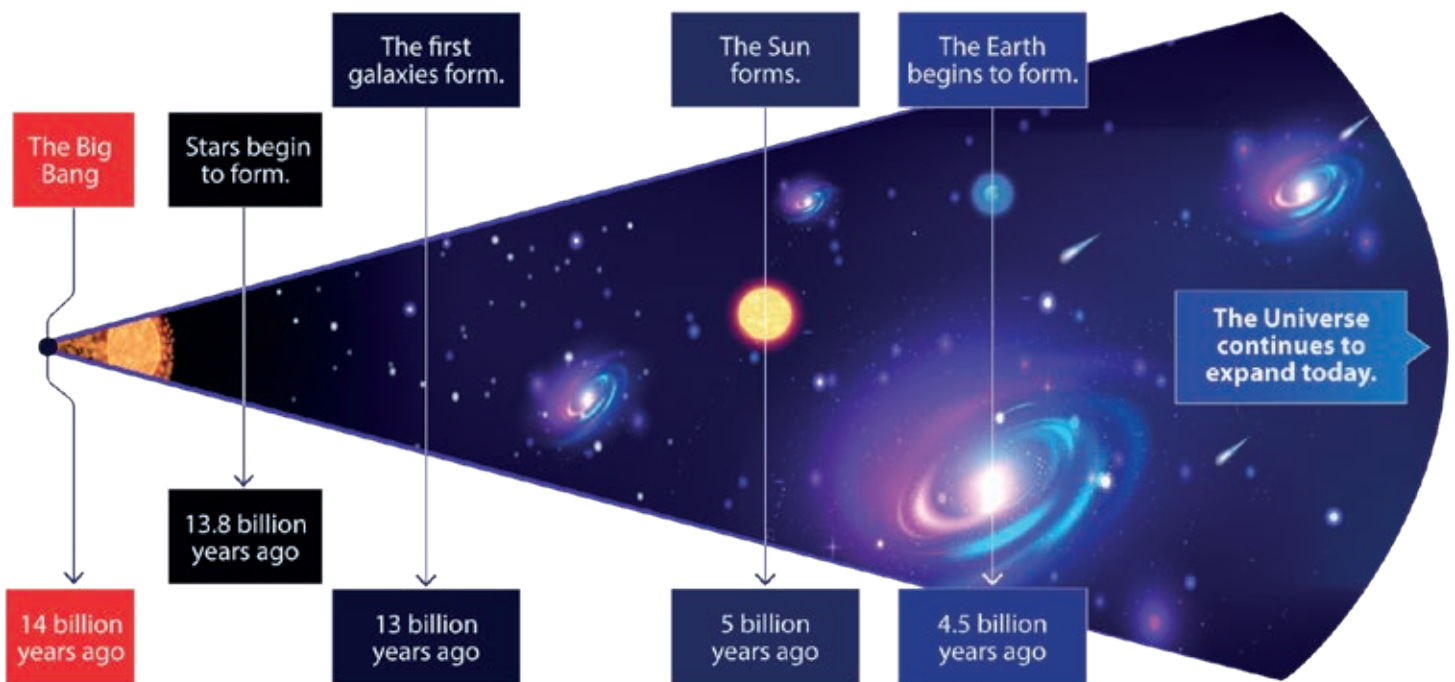
- How many planets in the Milky Way can you name?
- Why is it difficult to see the centre of the Milky Way?

5  The nearest galaxy to the Milky Way is the Andromeda galaxy. Do research on the Internet to answer the questions.

- What shape is it?
- Under what conditions can we see Andromeda from Earth without using a **telescope**?

The Big Bang theory of how the Universe began

Not everyone agrees about the way the Universe began. However, the theory that most astronomers accept is called **the Big Bang theory**. It states that at the beginning, all the matter in the Universe was concentrated into one incredibly small point. This point then exploded and got bigger and bigger. Over billions of years, all the astronomical objects that we know about today were created. The Big Bang theory also states that the Universe is still growing today.




6 Look at the diagram. Copy and complete the sentences.

- The first stars appeared years ago.
- The first galaxies appeared years ago.
- The Earth started to develop years ago.

How do we explore and find out about the Universe?

Astronauts travel into space in **spacecraft** and sometimes stay for several months working on the International Space Station. Sometimes unmanned spacecraft, which have no humans on them, travel to parts of the Solar System where humans can't survive.

Space exploration

1 Listen and write the missing years in your notebook.  003

a. In , 15 governments signed an agreement to develop the International Space Station. The first astronauts began working and living there in 2000.

b. The first human in space was Russian. Yuri Gagarin spent 108 minutes orbiting the Earth in .

c. In , the American Apollo 11 spacecraft landed on the Moon. Two American astronauts were the first people to walk on the Moon.

d. The first living thing to go into space was Laika, a Russian dog, in .

e. Pedro Duque was the first Spanish astronaut to visit the International Space Station. He was there for 10 days in .

f. NASA's unmanned Curiosity rover landed on Mars in August . It sends information back to Earth every day. Three antennas receive the information. One is in the Comunidad de Madrid.

2  Use the information from activity 1 to draw a timeline.

3 Work with a classmate. Ask each other questions about the history of space exploration.



The International Space Station

Observing the Universe

Since the beginning of the 17th century, humans have used telescopes to observe the sky at night. Now there are huge and amazingly powerful telescopes that are so big they need special buildings called **observatories**.

There are many large observatories in Spain. Two of the biggest are the Roque de los Muchachos observatory on La Palma and the Teide observatory on Tenerife. Other observatories include: the Yebes observatory in Guadalajara, the Hispano-German astronomical observatory in Almería, the Pico Veleta observatory and the Sierra Nevada observatory (both in Granada) and the Javalambre observatory in Teruel.



Roque de los Muchachos observatory

- 4** Research one of these observatories and make a presentation about it for your classmates.

Space telescopes

In addition to terrestrial telescopes, now there are telescopes in space. The first was the Hubble telescope, which was launched in 1990. It's about the size of a bus and has sent more than 1.5 million observations back to Earth. In October 2022 the James Webb telescope was launched and it soon began to send back incredible images from space.



Artificial satellites

There are many **artificial satellites** circulating the Earth. They're constructed in different ways and use different tools and software to provide scientists on Earth with a variety of data or services. These include:

- taking measurements to predict weather patterns
 - collecting data to help understand the structure and development of the Solar System
- recording images of the Earth showing things such as the distribution of water or forests
 - making telecommunications possible, such as mobile phone, GPS and television transmissions

Light pollution

Telescopes, even the really powerful ones, work best if there's no light pollution, so observatories are usually located in places where there is little or no artificial light.

- 5**  Look at the website of the Starlight Foundation and find out which Starlight Tourist Destination is closest to where you live.



At home

Ask your parents and other people in your family what they remember about space voyages they have seen and heard about.

Why do we have day and night?

The Earth, like all the planets in the Solar System, spins on its **axis**. The axis is an imaginary line that runs through the centre of the Earth, from the North Pole to the South Pole. The spinning of the Earth on its axis is called its **rotation**.

The Earth's rotation

The Earth rotates in an anticlockwise direction (from left to right). At the Equator, the speed of the Earth's rotation is about 1 600 km/h, but at the poles there's no movement.

We don't feel the movement of the Earth's rotation because it's constant, like when you travel in a car and the driver maintains the same speed.

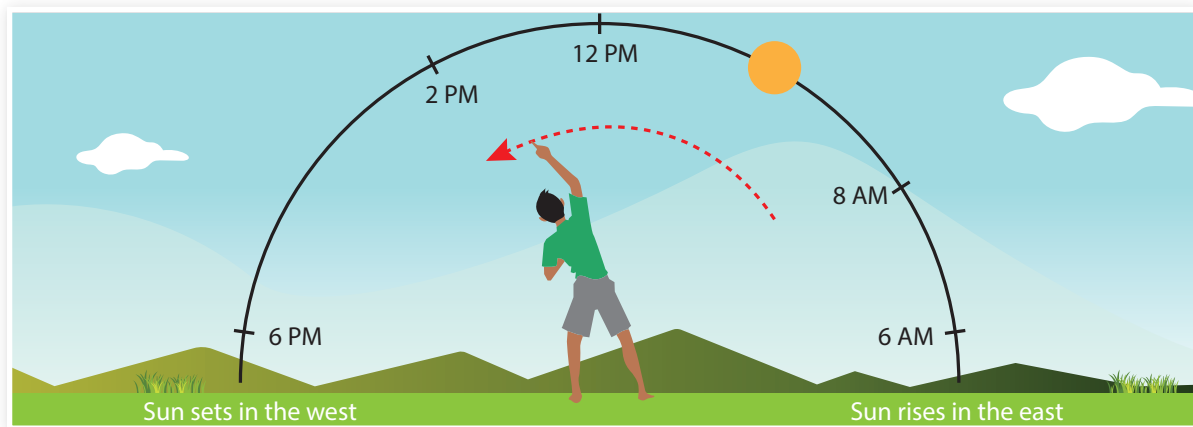
The Earth takes 24 hours to make one complete rotation on its axis.

- 1 Spin a globe, like the one in the photo. Look at the Equator and you'll see that it's moving quickly. Then move your eyes to look at the North Pole or the South Pole. Is it moving fast, slow or not at all?



Day and night

The Sun rises above the horizon in the east every morning and sets in the west at the end of each day. When we can see the Sun in the sky, it's light and it's daytime. When the sun disappears below the horizon, it's night-time.



- 2 Work with a classmate. Do you think the Sun is moving? Where do you think the Sun is when you can't see it?

Because the Earth rotates on its axis, there are times when the Sun shines on one side of the Earth, but the other side is in darkness. This is what creates day and night on Earth.



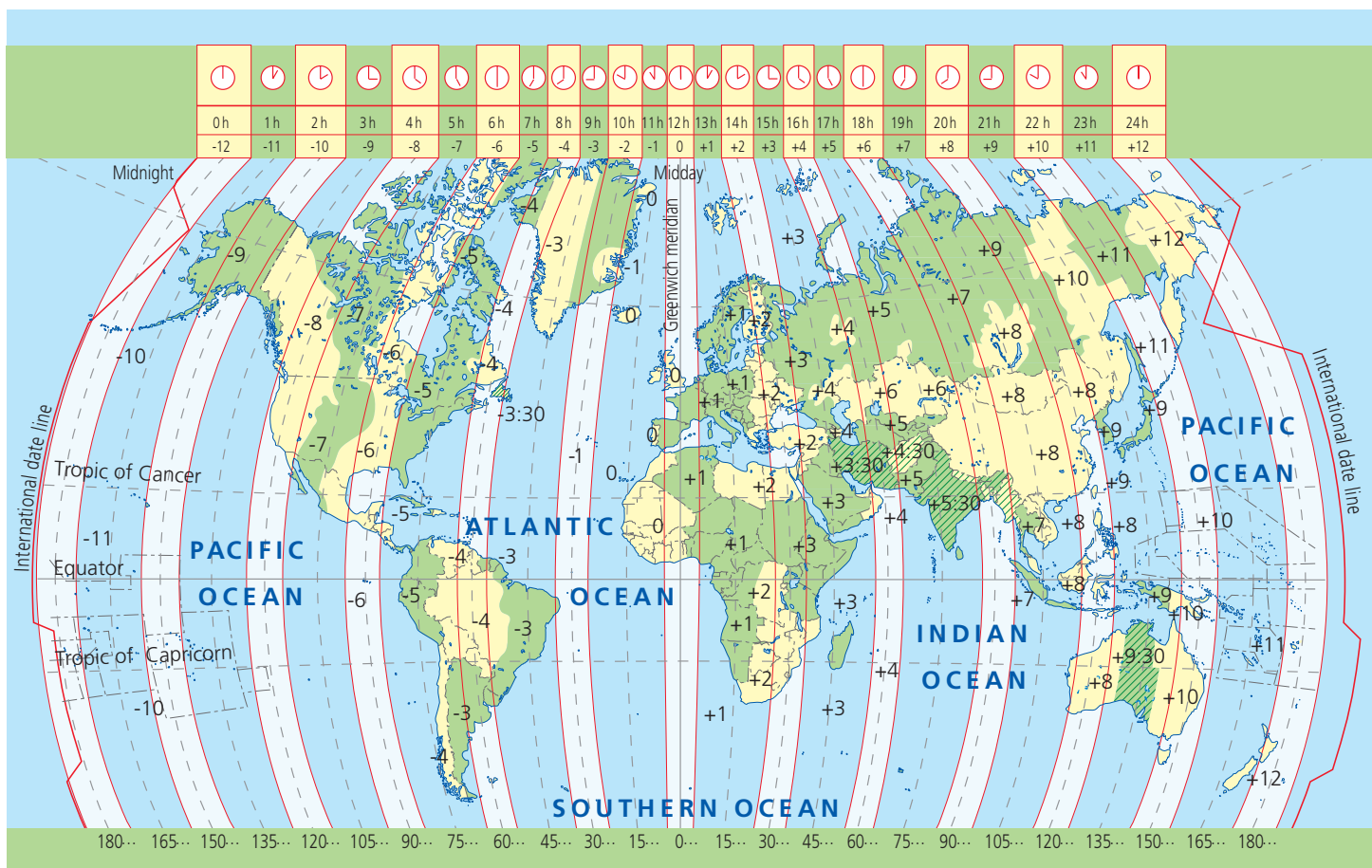
- 3 Shine a torch at a globe. Don't move the torch, but spin the globe slowly. You'll see which parts of the world experience day when other parts experience night. What does the torch represent in this experiment?



Time zones

The Earth's rotation means that different parts of the world experience day and night at different times.

There are imaginary lines from the North Pole to the South Pole, called **meridians**, which are used to divide the world into different **time zones**. The prime meridian passes through Greenwich in London. The time in countries to the east of the prime meridian is ahead of the time in the United Kingdom. In countries to the west, time is behind United Kingdom time. Large countries have often got more than one time zone.



- 4 Look at the map and answer the questions.
- How many time zones are there?
 - How many time zones are ahead of time in the United Kingdom?
 - Name a country that has got more than one time zone.

WOW

In Spain the Earth rotates at about 1 200 km/h.

How does Earth's revolution of the Sun affect us?

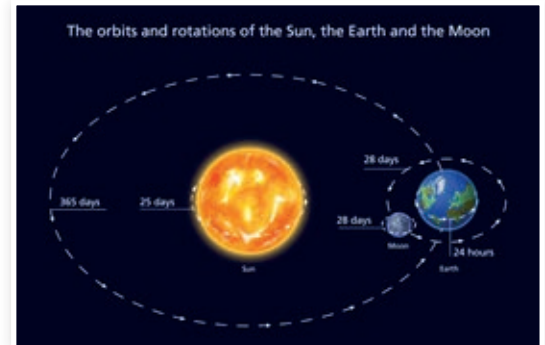
The Earth rotates on its axis, but it also moves in another way. It revolves around the Sun. We can also say that the Earth orbits the Sun. It takes 365 days, 5 hours, 59 minutes and 16 seconds for the Earth to make one revolution of the Sun.

Ancient civilisations thought that the Earth was at the centre of the Universe and that the Sun revolved around the Earth. Now we know that all the planets of the Solar System revolve around, or orbit, the Sun. In addition, some astronomical objects orbit planets. We call these satellites.

1 A calendar year is 365 days. Every four years we modify the calendar to take into consideration the extra 5 hours, 59 minutes and 16 seconds of the Earth's orbit of the Sun. Research the name of this modification.

2 Look at the diagram. What astronomical object revolves around the Earth?

3 Work with a classmate. Take turns to ask and answer how long the rotations and the orbits of the Earth, Moon and Sun are.



Solstices



San Juan celebrations in Valle de Arán, Lleida

The number of daylight hours changes as the Earth orbits the Sun. The day with the most hours of daylight is called the **summer solstice**, or the longest day. The Equator divides the Earth into the Northern Hemisphere and the Southern Hemisphere. In the Northern Hemisphere the summer solstice happens on 21st or 22nd June. Six months later the Northern Hemisphere experiences the shortest day, or **winter solstice**. This is on 21st or 22nd December. In many cultures the summer and winter solstices are celebrated with **bonfires**.

4 When are the winter and summer solstices in the Southern Hemisphere?

5 The ancient monument Newgrange in Ireland was constructed in around 3200 BC. This is before the Great Pyramids in Egypt were built! Research on the Internet to discover what special adaptation Newgrange has got that is only effective during the winter solstice.



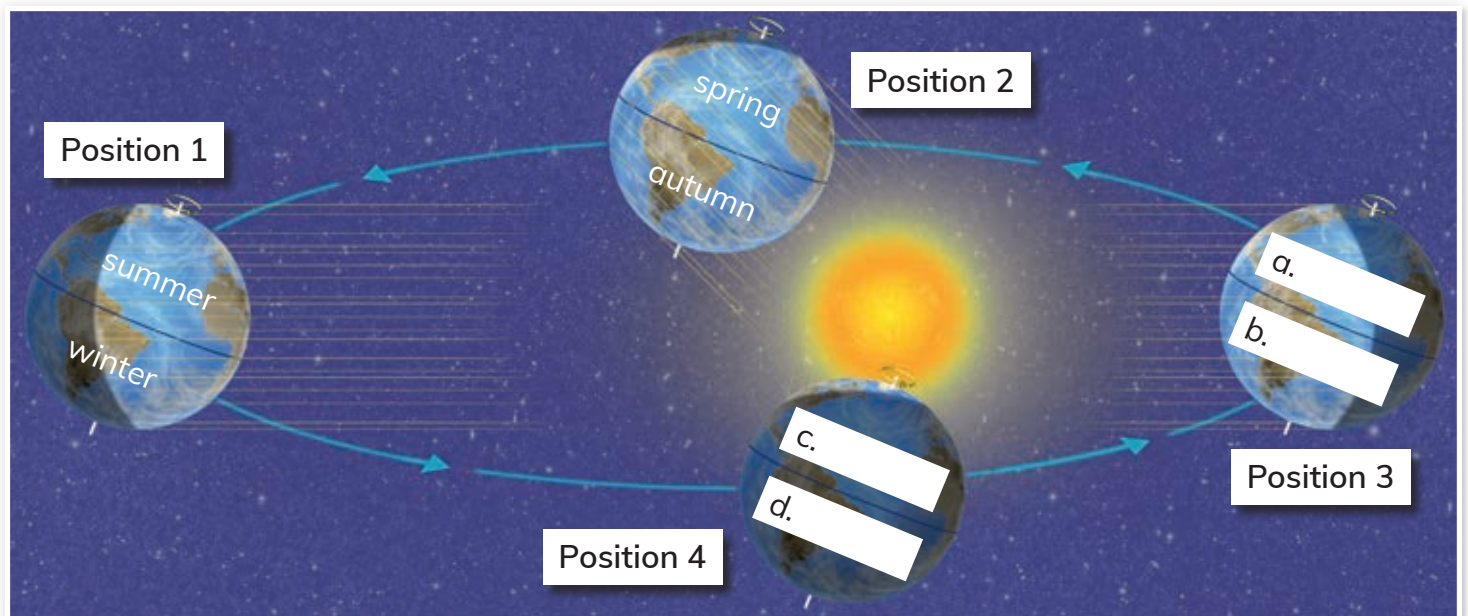
The four seasons on the Earth

The path of the Earth's revolution around the Sun is an **ellipse**, not a circle. Also, the axis of the Earth isn't vertical. In fact, it's tilted at an angle of about 23.5° . This affects how the rays of the Sun hit the Earth.

At Position 1 in the diagram of the Earth's revolution, the Northern Hemisphere is more tilted towards the Sun. When this happens, the Sun's rays hit the Northern Hemisphere more directly and it's summer in Europe. The Sun's rays hit the Southern Hemisphere less directly at this time and it's winter in Argentina. After six months, the Earth has orbited half way round the Sun and the Northern Hemisphere is tilted away from it. Now it's winter in Europe and summer in Argentina.

The angle of the Earth's tilt means that during the summer solstice the pole that is tilted towards the Sun experiences 24 hours a day of sunlight. For example, in Position 1 in the diagram, there is no night-time at the North Pole.

- 6** In your notebook, write which season it is in the parts of the world labelled a. to d.



- 7**  Look at the diagram again and answer the questions.

- How many months are there between Positions 1 and 3 of the Earth?
- How many months are there between Positions 1 and 2 of the Earth?
- In Position 3, how many hours of daylight does the North Pole experience?
- In Position 3, how many hours of daylight does the South Pole experience?

WOW

The Earth revolves around the Sun at a speed of about 107 000 km/h!

How does the Moon affect the Earth?

The Moon is a satellite of the Earth. It affects our daily lives in different ways. Sometimes it illuminates us at night, sometimes it causes solar eclipses, and it also controls the tides of the oceans and seas.

1  **Watch.** How many phases of the Moon are there?

The dark side of the Moon

The Moon doesn't produce its own light. However, we can see it sometimes because it's illuminated by light from the Sun.

The rotation of the Moon and its orbit of the Earth both take around 28 days. Because of this, the same side of the moon is always directed towards the Earth. The side that we can't see we call **the dark side of the Moon**.

2 **Read the texts above. Then listen to the two students talking. Write the two mistakes they make in your notebook.**  004

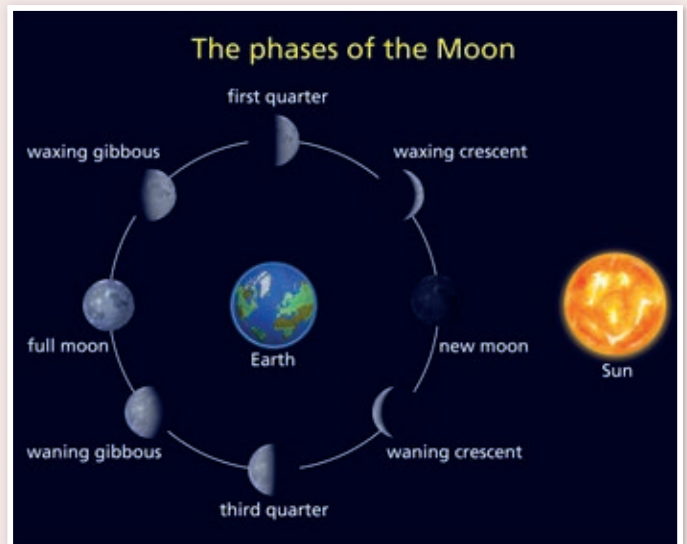
The phases of the Moon

At certain times in the Moon's orbit of the Earth, it's between the Earth and the Sun. At these times, on Earth we can't see the Moon. At other times the Moon is completely lit by the Sun, and sometimes only parts of it receive the Sun's light.

We call this phenomenon of seeing different parts of the Moon at different times **the phases of the Moon**.

3 **Read the text, look at the diagram and match each sentence to a phase of the moon.**

- From Earth, we can see half of the Moon illuminated. The bright side is on the right.
- We see half of the illuminated face. The bright side is on the left.
- The Moon is exactly between the Earth and the Sun and it's almost impossible to see it.
- The Earth is between the Moon and the Sun.
- The side of the Moon that faces the Earth receives no sunlight.
- We can see the fully illuminated face of the Moon.

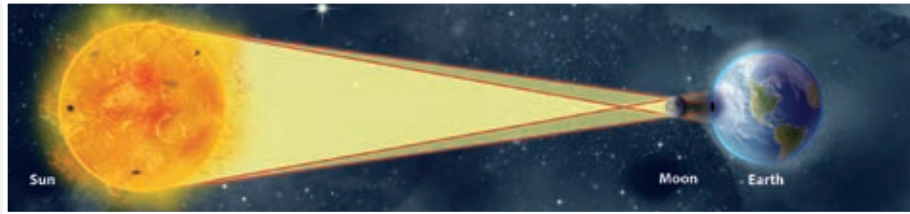


Eclipses

There are two types of eclipse: solar eclipses and lunar eclipses.


A **solar eclipse** occurs when the Moon is between the Earth and the Sun. When this happens, some of the Sun's light is blocked and we see a **shadow** over the Sun. When the shadow covers part of the Sun, this is a **partial eclipse**. When all the light from the Sun is blocked by the Moon, this is a **total eclipse**.

You must never look directly at the Sun because it damages your eyes. You can buy special glasses to wear to watch a solar eclipse.



A **lunar eclipse** occurs when the Earth is between the Sun and the Moon. This means that some or all of the Sun's rays are blocked. Lunar eclipses can also be partial or total. Partial eclipses last many hours, but total eclipses only last a few minutes.



- 4**  **Work in small groups. Make a model to demonstrate solar and lunar eclipses.**
- Use a torch or lamp for the Sun, a globe or big ball for the Earth and a small ball for the Moon.
 - Put the large ball and the lamp on a table. If you use a torch you can put it on top of some books on the table.
 - Hold the small ball between the lamp/torch and the big ball. Which type of eclipse does this model represent?
 - Now can you make a model of the other type of eclipse?

The Moon's effect on the oceans and seas

The Moon is about 385 000 km from the Earth, but its gravitational pull causes the changes we see every day in the level of seas and oceans. A **high tide** is when the water covers a lot of the beach. When there is a **low tide** you can see much more of the beach.



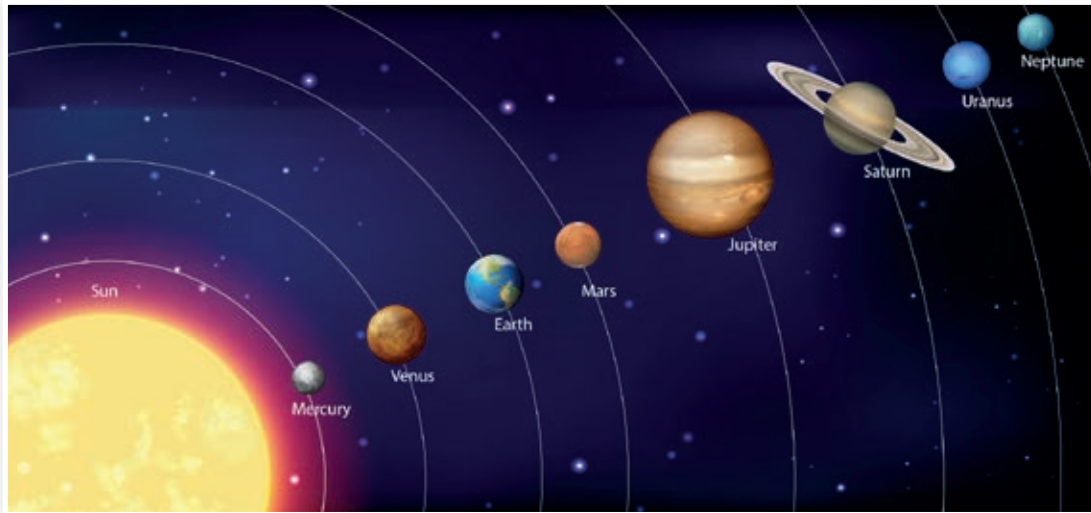
At home

Research the times of high tide and low tide in a Spanish coastal city or town over the period of a month.

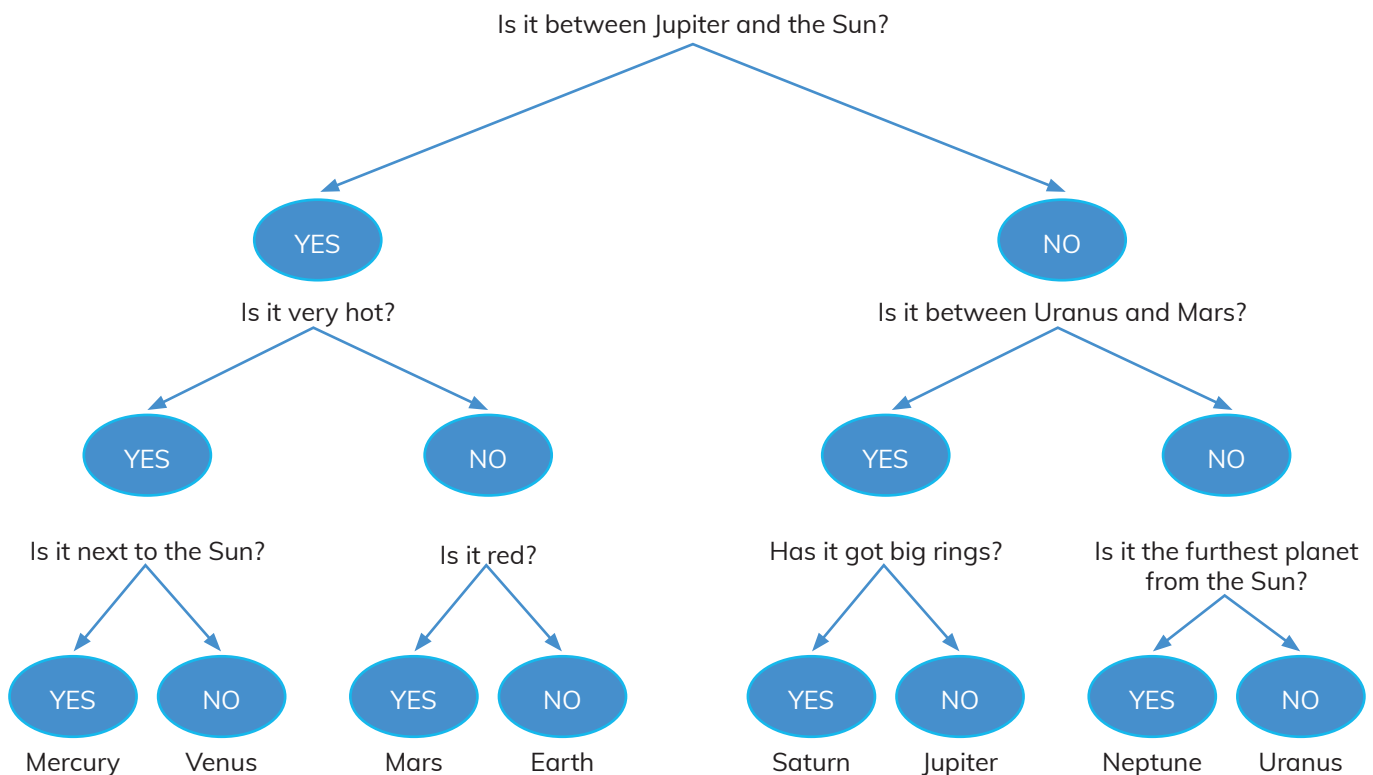
What astronomical objects are there in our Solar System?


Because the Earth and seven other planets revolve around the Sun, this special collection of astronomical objects is called the Solar System.

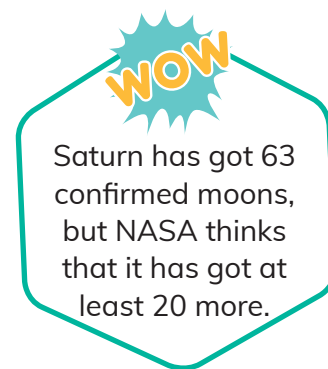
- 1 **Watch.** Where are the two asteroid belts in the Solar System?



- 2 Look at the picture and list the planets in the Solar System in order of size.
- 3 Look at the identification key. Listen and discover which planet the girl is thinking about. 005



- 4 Work with a classmate and play the game. Take it in turns to think of a planet. Your classmate uses the identification key in activity 3 to discover which planet it is.
- 5  Look at the interactive map and click on one of the planets to find out more about it. Answer the questions.
- Which planet is the hottest?
 - Which planet is the coldest?
 - How close to the Sun is the Earth?
 - Which planet has got the longest days?
 - Which planet has got the shortest days?
 - Which planet has got the longest years?
 - Which planet has got the shortest years?



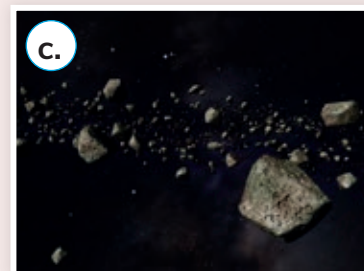
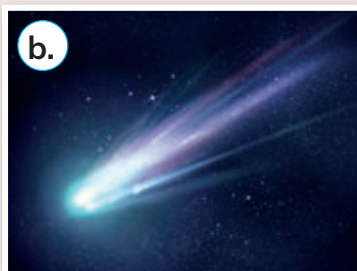
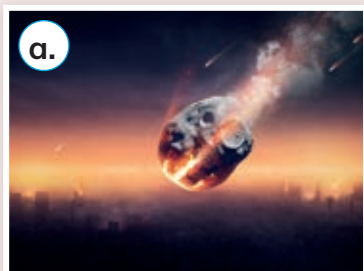
Other astronomical objects in the Solar System

In addition to planets and stars, the Solar System also contains other astronomical objects: satellites, comets, asteroids and meteoroids.

Satellites are astronomical objects that orbit a planet. They are often called 'moons.' The Earth has got one satellite: the Moon. Mercury and Venus haven't got any satellites, but the rest of the planets have got two or more.

Comets, asteroids and meteoroids are similar, but different!

- 6 Read and decide which astronomical object is shown in each photo.



Comets orbit the Sun and are made of ice, rocks and dust. The ice vaporises because of the Sun's heat and the water vapour mixes with dust and forms a tail behind the comet. Halley's comet sometimes passes close to Earth and we can see it.

Asteroids are large rocks that orbit the Sun, mostly in the space between Mars and Jupiter.

Meteoroids are small pieces that break off asteroids or comets, usually after a collision. Sometimes meteoroids enter the Earth's atmosphere, where they usually disintegrate and burn up. These are the 'shooting stars' we sometimes see at night, but astronomers call them meteors. Occasionally a meteor doesn't break up completely and some space rock hits the ground. This is called a **meteorite**.

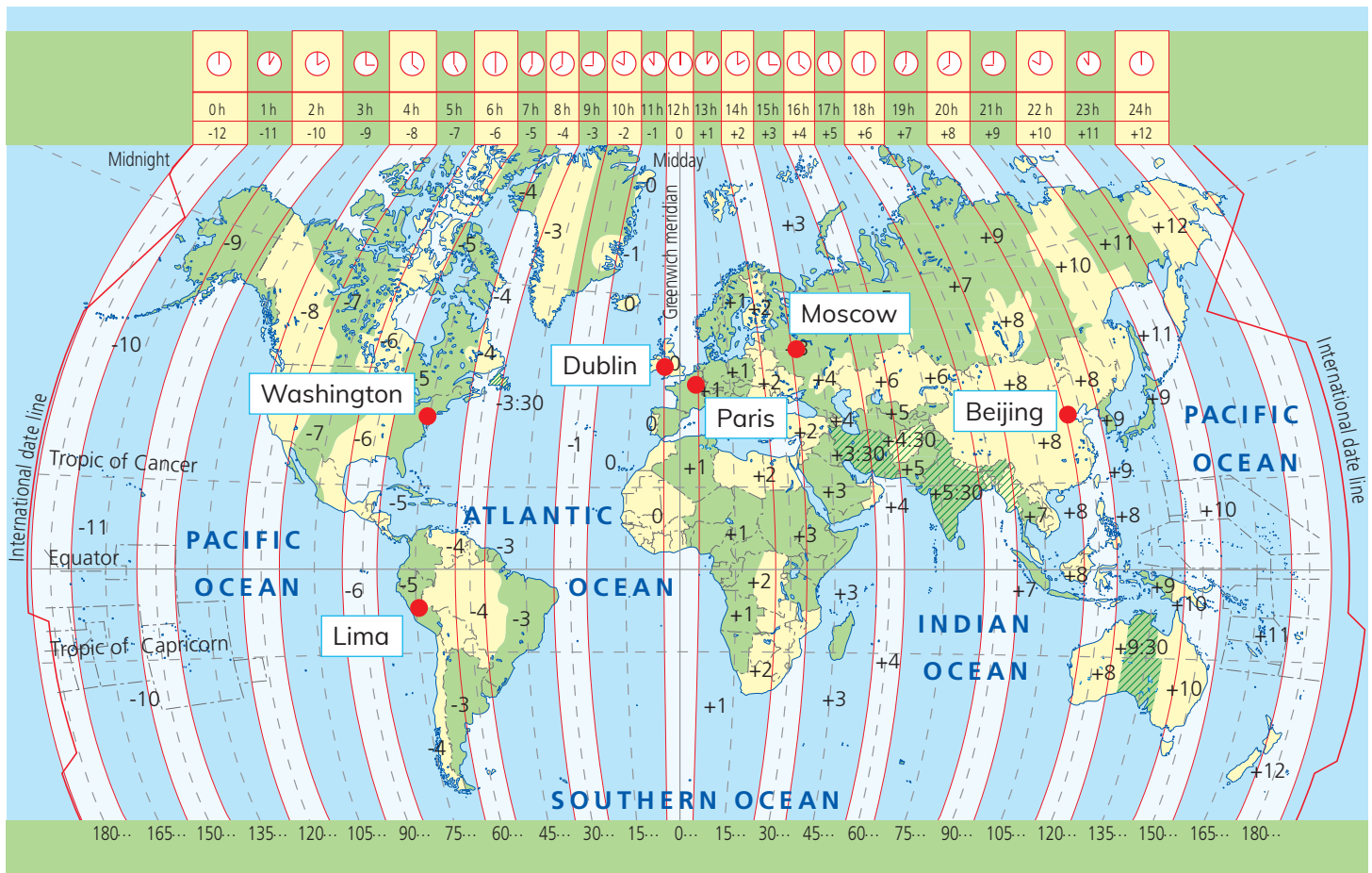


At home

Find out the last time and the next time that we will see Halley's comet from the Earth.

Can you calculate the time in different parts of the world?

Earth is divided into 24 time zones.



1 Look at the map and answer the questions.

- Is mainland Spain ahead of UK time or behind it?
- If it's 3 pm in Madrid, what time is it in these capital cities?

Washington

Moscow

Beijing

Paris

Lima

Dublin

2 With a classmate, ask and answer questions about the time difference in different cities on the map.

If it's 3 p.m. in Paris, what time is it in Washington?

Washington is six time zones to the west, so it's 9 a.m.


3 Research on the Internet how and why Greenwich was chosen as the prime meridian.



Tip 1

Think about the similarities and differences of words in Spanish and in English

Some words used in astronomy, which is the study of the Universe, are similar in Spanish and English. That makes them easier to learn, although sometimes the pronunciation isn't exactly the same. For example, the stressed syllable may be different.

- 1  Copy the table in your notebook. Complete it with other astronomy words from the unit. Add the Spanish translation. Underline the stressed syllable in each word.

Similar		Different	
English	Spanish	English	Spanish
<u>a</u> steroid	astero <u>i</u> de	Earth	
plan <u>e</u> t		Moon	
space explora <u>t</u> ion		space <u>c</u> raft	

Tip 2

Think about the form of the past tense of verbs. Is it regular or irregular?

- 2 Read the sentences and complete them with the past tense of the verb in brackets.
 - a. The Big Bang more than 13 billion years ago. (happen)
 - b. A meteorite Chelyabinsk, Russia, on 15 February 2013. (hit)
 - c. The first astronauts on the Moon in 1969. (land)
 - d. NASA the Curiosity rover to Mars in 2011. (send)


Tip 3

Make a mind map

Mind maps are good for organising the content of the unit. They are also a great revision tool.

- 3 Work in pairs
 - a. Choose one of the following topics and make a mind map.
 - the Universe
 - the Earth's rotation
 - the Earth's orbit of the Sun
 - b. Present your mind map to another pair who chose a different topic and ask if they've got any questions.

Story

1 Read and listen.  006

2 Find the words in the story.

comet

satellite

dust

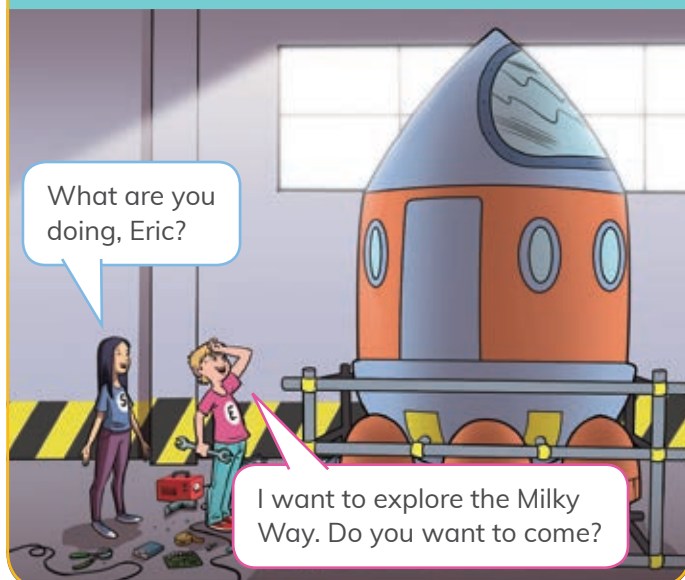
source

orbit

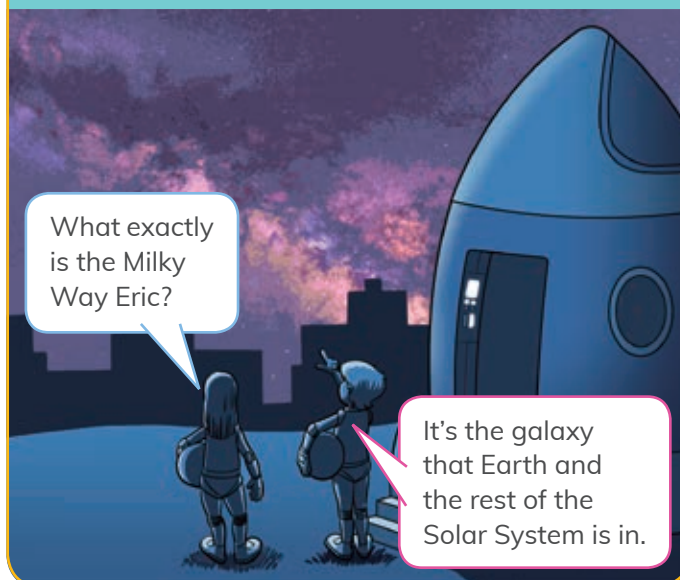
scared

No better place than Earth!

Eric is changing his machine into a spacecraft.



Galaxies are composed of millions of stars and planets, and a lot of gas and dust.



The kids fly towards the Sun. It's the source of light and heat for life on Earth.



They travel to Mars, the next planet to the Earth, travelling away from the Sun.



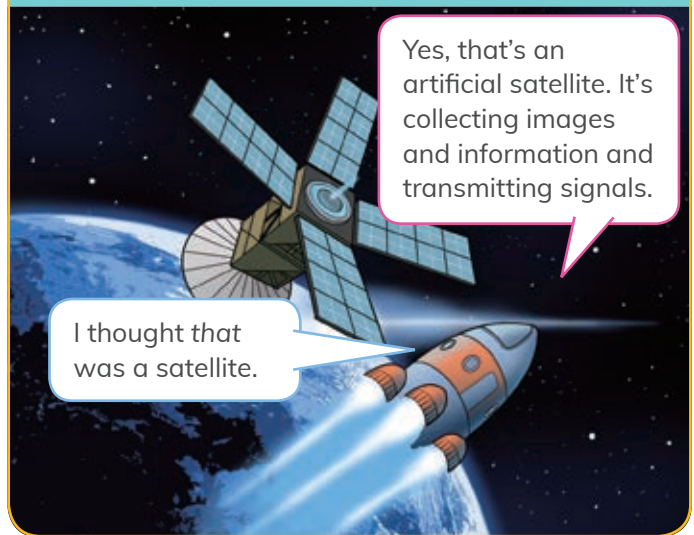
The kids see the Moon orbiting the Earth.



The Moon!! Humans have walked on planet Moon, right?

Yes, but it's not a planet. It's a satellite that orbits the Earth.

They see something else orbiting the Earth. It's an artificial satellite that makes telecommunications possible.



Yes, that's an artificial satellite. It's collecting images and information and transmitting signals.

I thought that was a satellite.

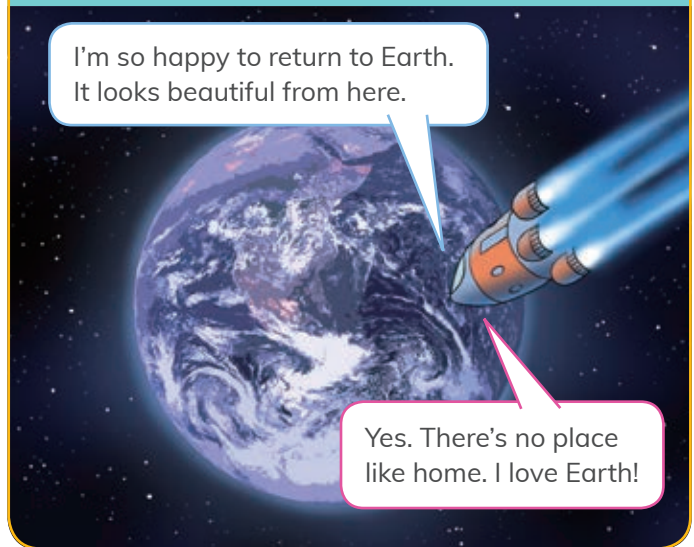
While they're travelling, the kids see another type of astronomical object.



That's Halley's comet. The next time we can see it from Earth will be in 2061!

That's a comet! I'm scared!

The kids are going home. Earth looks blue from space because of all the water on planet Earth.



I'm so happy to return to Earth. It looks beautiful from here.

Yes. There's no place like home. I love Earth!

3 Answer the questions in your notebook

- Why is Eric modifying his machine?
- What part of the Universe are they going to visit?
- What type of astronomical object passes close to the spacecraft?
- What's the name of the comet that they see?
- Which astronomical object is the Moon orbiting?
- What do artificial satellites do in space?
- Do the STEAM kids want to stay in space?

Pablo Álvarez Fernández and Sara García Alonso



In November 2022 the European Space Agency (ESA) chose its class of 2022. More than 22 000 people applied but only 17 were chosen. Two are Spanish.

Pablo Álvarez Fernández was born in León in 1988. He studied aeronautical engineering in Spain and Poland. He has worked on projects in France, Spain and the United Kingdom and speaks Spanish, English, Polish and French fluently. He

likes running and cycling. It was always his dream to become an astronaut and he worked on the ESA ExoMars rover project. Pablo is now a career astronaut. He'll train for 12 months at the European Astronaut Centre in Cologne, Germany and will probably go to the Moon or Mars.


Sara García Alonso was born in León in 1989. She has got a doctorate from the University of Salamanca and leads a team investigating drug treatments for cancer at the Spanish National Cancer Research Centre. Sara is fluent in Spanish and English and speaks a little French and Portuguese. She likes scuba diving, which is useful: astronauts train underwater because it simulates some of the conditions in space. She is a reserve astronaut. She'll continue in her current job but also do some training in case ESA starts more space projects.

1 Write Pablo or Sara in your notebook.

- | | |
|---|--|
| a. Who always wanted to be an astronaut? | d. Whose hobby helped them to be selected? |
| b. Who is going to move to live in Germany? | e. Who speaks most languages fluently? |
| c. Who is older? | f. Who is responsible for a team of researchers? |

WebQuest



2  Do you recognise this place? It's the Gran Telescopio Canarias (GTC). When you finish your WebQuest, answer the questions in your notebook.

- What's the diameter of the CTC?
- Name two institutions who collaborate with GTC.
- When was the GTC first used? Sometimes this is called the First Light Ceremony.





Challenge

My rocket launcher

Can you make a rocket launcher?



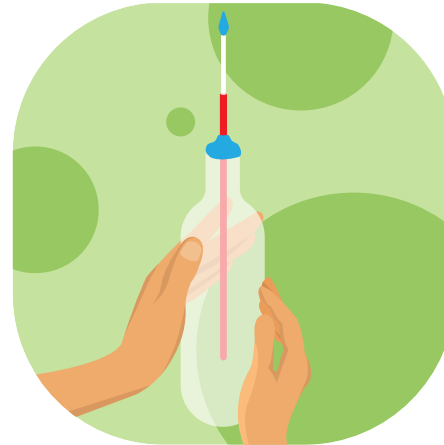
Before you start

The European Space Agency uses a launch site in Kourou in French Guiana for many of its missions.

- 1 Find out where *Apollo 11*'s mission to the Moon was launched from.
- 2 What materials could you use to make your own rocket launcher?

You need ...

- 2 straws of different diameters. The narrower straw must fit inside the wider straw.
- a flexible/squeezable plastic bottle with a narrow mouth
- modelling clay



Planning

- 3 Insert one end of the narrower straw into the opening of the bottle.
- 4 Use the modelling clay to keep this straw vertical in the mouth of the bottle. Make sure that no air can escape between the straw and the mouth of the bottle.
- 5 Use some more modelling clay to close one end of the wider straw. Make it pointed, like the nose of a plane, and make sure no air can escape from this end of the straw.
- 6 Hold the nose of the wider straw and place its open end over the narrower straw.
- 7 Squeeze the bottle. The wider straw will fly into the air.
- 8 Have a competition with your classmates. See who can launch their straw rocket the furthest.



1 Answer the questions in your notebook.

- What are comets?
- What are most asteroids made of?
- Which planet is between Venus and Mars?
- What's the name of our galaxy?
- When did space exploration begin?
- What's the Earth's rotation?
- Why is there day and night on Earth?
- What does the Earth orbit?

2 Read the text. Then decide if the sentences below are true or false. Correct the false sentences.



The Universe contains millions of galaxies, each one composed of astronomical objects such as stars, asteroids and meteoroids. Between astronomical objects, and between galaxies, there are huge empty spaces. We know that the Universe is enormous, but astronomers still don't know exactly how big it is. They also believe that it's still expanding. Most scientists think the Universe began as a result of a huge explosion. The British astronomer Fred Hoyle created the term 'the Big Bang theory' to refer to this explanation for the origin of the Universe.

Most of the time you can only see individual stars in the night sky, although if you live in a place without light pollution you can sometimes see the Milky Way. At certain times of the year you may also see shooting stars, which are pieces of space rock that have fallen into the Earth's atmosphere.

- The Universe only contains stars.
- Stars and galaxies are close together.
- Many people think the Universe is getting bigger.
- An American astronomer invented the term 'Big Bang Theory'
- You can see the Milky Way every night.
- Shooting stars are dead stars.

3 In your notebook explain the difference between:

- a meteor and a meteorite
- a comet and an asteroid
- a galaxy and a solar system

4 Do the quiz!



Reflect

1 Read the unit objectives and say what you have learned. Write one thing you can do and one thing you need more practice with.

I can ...



explain what **comets, satellites** and **asteroids** are.



I can ...



explain why there are different **time zones** in the world.



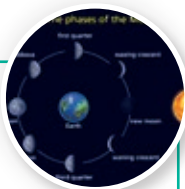
I can ...



describe the characteristics of **the planets in the Milky Way**.



I can ...



explain what **lunar phases** and **eclipses** are.



I can ...



describe the **negative effects of light pollution**.



I can ...



calculate the time in different time zones compared to mainland Spain.



I can ...



explain who **Pablo Álvarez** and **Sara García** are.



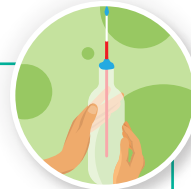
I can ...



use the Internet to research the **GTC**.



I can ...



make a **rocket launcher**.



Key:

- I'm not sure.
- I need some practice.
- I understand.

2 How do you want to show what you have learned about the Milky Way or the Solar System in this unit?

do a presentation

make a poster

write an article