●●○○○ **Level 2 · Science** S2.9

Earth, Sun and Moon

Why day turns to night, and why the Moon changes shape.

Model the Sun, Earth and Moon, show day and night with a lamp and a ball, find east and west with a shadow stick, learn why some years have an extra day, follow the Moon round the Earth and its phases, and see how eclipses happen.

YOU ARE READY FOR THIS BOOK IF

You can draw the shape of the Moon you saw last.

One step up	S3.11 Rocks, soil and fossils
This book	**S2.9 Earth, Sun and Moon**
One step down	S1.7 Day, night and weather

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S2.9.3 The Sun seems to move

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S2.9.5 The Moon goes round the Earth

S2.9.6 Phases of the Moon

S2.9.7 Eclipses

Key words, A to Z

Written and drawn by attnom. Free to read, print and share.

S2.9.1 CHAPTER 1

Sun, Earth and Moon

What are the Sun, the Earth and the Moon?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** The Sun and the Moon are the same size.
- ☐ **B** All three are balls. Only the Sun makes its own light.
- ☐ **C** The Sun and the Moon are both stars.

BY THE END YOU CAN

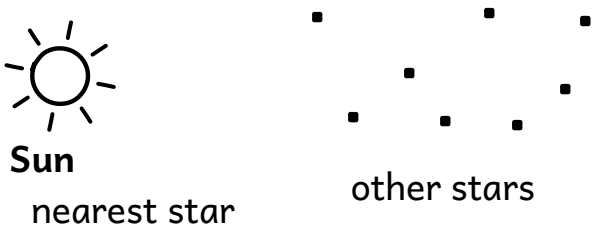
- Explain the Sun is a star, and Earth and Moon are balls
- Model the sizes of the Sun, Earth and Moon with round objects

Three big things shape our days and nights. They are the Sun, the Earth and the Moon. You live on the Earth.

Be safe. Never look at the Sun. Not for a moment. Not through glass, sunglasses, cloth, a tube or a phone camera. Not in a mirror. It can hurt your eyes for ever. Look only at shadows and marks on the ground or on paper.

The Sun is a ***star***. A star is a huge ball of very hot, glowing ***gas***. Gas is stuff like the air. You cannot hold it.

The Sun makes its own light and heat. It is the star nearest to us. The stars you see at night are like our Sun. They are far, far away.

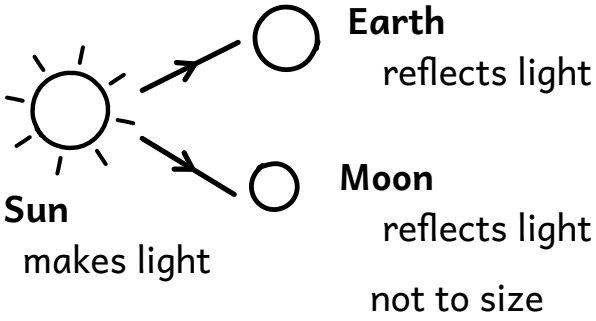


The Sun is a star. The other stars look like dots because they are so far away. Not to size.

The Earth is a ball of rock. It has water and air round it. The Earth is not a star. Its daylight comes from the Sun.

The Moon is a smaller ball of rock. It has no air. The Moon makes no light of its own. Sunlight lands on it and lights it up.

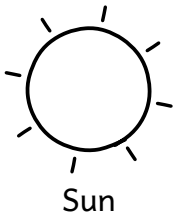
To **reflect** is to send light back. The Moon reflects sunlight. So does the Earth.



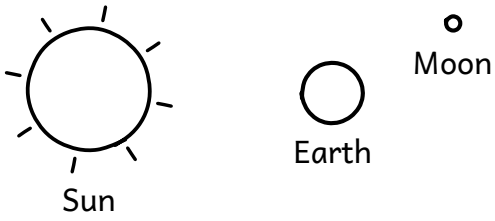
Only the Sun makes light. The Earth and the Moon send some of it back. Not to size.

DRAW IT FIRST

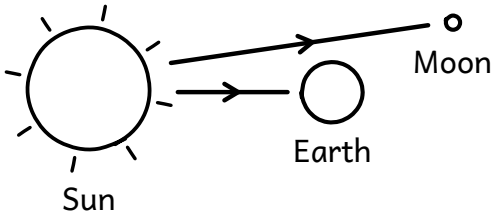
Draw the Sun, Earth and Moon



1 Draw a big ball on the left for the Sun. Write Sun.



2 Draw a smaller ball for the Earth. Draw a tiny one for the Moon. Write both names.

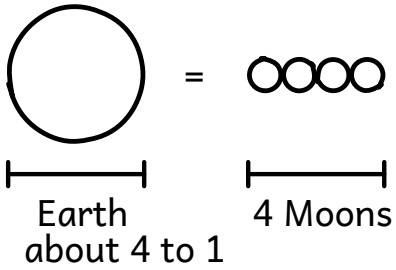


not to size

3 Draw an arrow from the Sun to the Earth. Draw one to the Moon. Write not to size.

This picture is not to size. The real Sun is much, much bigger.

The Sun is about 109 times as wide as the Earth. The Earth is about 4 times as wide as the Moon.



About four Moons side by side are as wide as the Earth.

You can show this with a **model**. A model is a small copy of something big.

SEE IT THREE WAYS

As a picture



Sun
hot gas, makes light



Earth
rock, water, air



Moon
rock, no air

In words

The Sun is a star. It makes its own light. The Earth and the Moon are balls of rock.

In symbols

Sun = 109 Earths wide. Earth = 4 Moons wide.

Say the Earth is a pea, 1 cm wide. Then the Moon is a seed, about 3 mm wide. Hold the seed 30 cm from the pea.

The Sun is then a ball about 1 m wide. It is more than 100 m away.

TRY IT

Make a model of the Sun, Earth and Moon

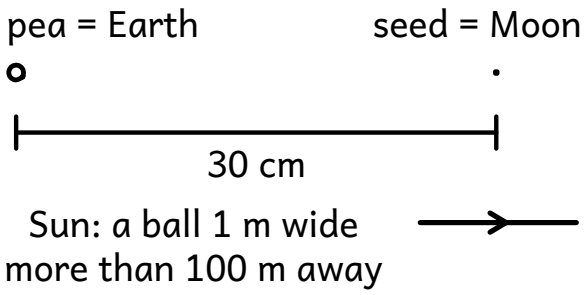
You need: a pea or a small bean, about 1 cm wide, a grain of rice or a tiny seed, a ruler or a sheet of writing paper, a string 50 cm long, a stick, flat ground outside.

Be safe: Never look at the Sun while you work outside. Look only at the ground. Never put the pea or the seed in your mouth.

1. Put the pea on a flat place. It is the Earth.
2. Measure 30 cm from the pea. A sheet of writing paper is about 30 cm long. Put the rice there. It is the Moon.
3. Go outside. Tie the stick to one end of the string.
4. Hold the other end on the ground. Pull the string tight.
5. Walk the stick round and scratch a circle on the ground. It is 1 m wide. It is the Sun.
6. Walk away from the circle. Count 200 steps. That is about 100 m. The real distance is a little more.

What you will see: The pea is tiny beside the Sun circle. The seed is even smaller, and close to the pea. The Sun is huge and very far away.

If you cannot try it, this is what happens.



A WRONG IDEA MANY PEOPLE HAVE

~~The Sun and the Moon are the same size.~~

Why it feels right: In the sky, the Sun and the Moon look the same width.

The test that breaks it: Far things look small. Hold up your thumb at arm's length. Cover a house or a tree far away. The big thing looks smaller than your thumb. Look only at things on the ground, never at the Sun.

What is true: The Sun is about 400 times as wide as the Moon. It is also about 400 times as far away. So they look alike.

KEY WORDS

star
a huge ball of hot, glowing gas that makes its own light. The Sun is a star.

gas
stuff like the air. You cannot hold it.

model
a small copy of something big.

reflect
to send light back.

BACK TO YOUR GUESS

The answer is B: All three are balls. Only the Sun makes its own light.

All three are balls. The Sun is a star and makes its own light. The Moon makes none.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. What is the Sun?

   A A star: a huge ball of hot, glowing gas

   B A ball of rock, like the Moon

   C A big Moon that makes light

   Answer at the back of the book.

2. The Moon shines at night. Where does its light come from?

   A The Moon makes it, like the Sun does

   B The Earth makes light for the Moon

   C The Sun lights the Moon

   Answer at the back of the book.

3. The Earth is a pea 1 cm wide. The Sun is 109 times as wide as the Earth. How wide is the Sun model?

   Answer at the back of the book.

4. The Earth is about 4 times as wide as the Moon. A bead for the Earth is 12 mm wide. How wide is the bead for the Moon?

   Answer at the back of the book.

5. Mei says the Sun and the Moon are the same size. They look alike in the sky. Is she right?

   A Yes. They look alike, so they are the same size.

   B No. The Sun is much bigger, but much farther away.

   C No. The Moon is bigger, but it is farther away.

   Answer at the back of the book.

6. Draw the Sun, the Earth and the Moon, from biggest to smallest. Write which one makes light.

   Answer at the back of the book.

7. Which sentence about the Sun, the Earth and the Moon is true?

   A The Moon is a small star that shines at night.

   B The Earth is a star, because it has daylight.

   C The Sun is a ball of rock that is very hot.

   D Only the Sun is a star. The Earth and the Moon are balls of rock.

   Answer at the back of the book.

8. Kofi makes a model. The pea is the Earth, 1 cm wide. The seed is the Moon. How far from the pea does Kofi put the seed?

   A 100 m from the pea

   B Right next to the pea

   C 10 cm from the pea

   D 30 cm from the pea

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

The Sun is a star, a huge ball of hot glowing gas. It makes its own light. The Earth and the Moon are balls of rock. The Sun is 109 Earths wide. The Earth is 4 Moons wide.

Draw: Draw a big ball, a small ball and a tiny ball. Write Sun, Earth and Moon.

S2.9.2 CHAPTER 2

Why we have day and night

Why does it get dark at night?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** The Earth spins, so each place turns away from the Sun.
- ☐ **B** The Sun goes behind the hills.
- ☐ **C** The Moon covers the Sun every evening.

BY THE END YOU CAN

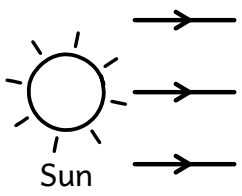
- Show day and night with a lamp and a spinning ball
- Explain why half of the Earth has day while half has night

Every place has day, then night, then day again. Why? The Sun is always shining. But it lights only half of the Earth at a time.

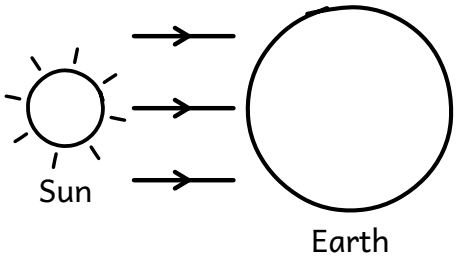
Be safe. Never look at the Sun. Not for a moment. Not through glass, sunglasses, cloth, a tube or a phone camera. Not in a mirror. Look only at shadows and marks on the ground or on paper.

DRAW IT FIRST

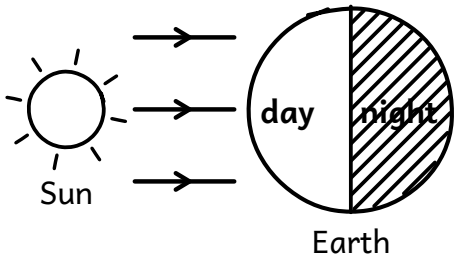
Draw the Sun lighting half of the Earth



1 Draw the Sun on the left. Draw three arrows of light going right. Write Sun.



2 Draw the Earth, a big ball on the right. Write Earth.



3 Draw a line down the middle. Shade the half away from the Sun.

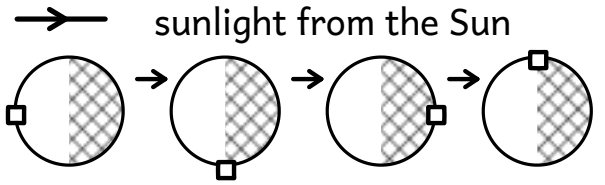
The half of the Earth that faces the Sun has day. The Sun lights it.

The other half faces away from the Sun. No sunlight reaches it. There it is night.

The Earth does not stand still. It is always turning. To **spin** is to turn round and round, like a wheel.

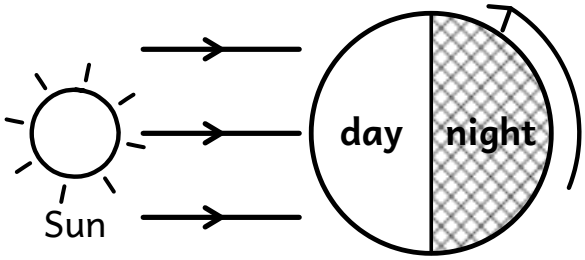
The Earth makes one spin in about 24 hours. We call that time a day.

As the Earth spins, your place moves into the dark. Later it moves back into the light.



seen from above the North Pole

Seen from above the North Pole, one place goes through one day. It goes into the dark, then back into the light.



Earth

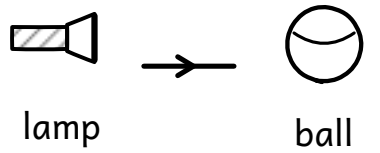
The Earth from high above. Not to size. The arrow shows the spin.

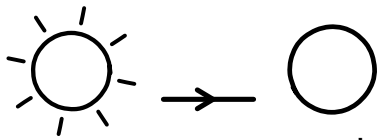
Daytime is when your place faces the Sun. **Night** is when it faces away.

The Sun does not go away at night. Your place turns away from it.

SEE IT THREE WAYS

As a picture





In words

The lamp is the Sun. The ball is the Earth. The mark is your place. Turn the ball, and the mark goes from light to dark.

In symbols

1 spin = about 24 hours = 1 day

TRY IT

Make day and night

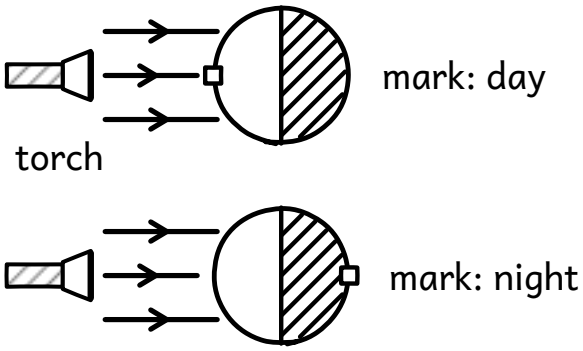
You need: a torch or battery lamp, or a candle, a ball, an orange or a lump of clay, a pen, a room you can make dark.

Be safe: A grown up lights and holds any candle. Keep hair, cloth and paper away from the flame. Never shine a torch into anyone's eyes. Never use a lamp plugged into a wall socket. Never look at the Sun.

1. Draw a small mark on the ball with the pen. It is where you live.
2. Make the room dark. Put the lamp on a table, shining across the room.
3. Hold the ball in the light, a little way from the lamp.
4. Look at the ball. Which half is lit? Which half is dark?
5. Keep the lamp still. Turn the ball slowly, one full turn. Watch your mark.

What you will see: Half of the ball is lit. The other half is dark. As you turn it, your mark goes into the dark. Then it comes back into the light. The lamp does not move. One full turn is one day.

If you cannot try it, this is what happens.



A WRONG IDEA MANY PEOPLE HAVE

~~Night comes when the Sun goes behind the hills.~~

Why it feels right: In the evening you watch the light sink behind hills or trees. Then it gets dark.

The test that breaks it: Use the lamp and the ball. The ball has no hills. Turn it, and the mark still goes dark. On flat land, the light on the ground fades at dusk. No hill is near. Never look at the Sun.

What is true: Night comes when your place turns away from the Sun. The Sun does not hide behind hills. Your place turns away from it.

KEY WORDS

spin
to turn round and round, like a wheel.

daytime
the time when your place faces the Sun.

night
the time when your place faces away from the Sun.

BACK TO YOUR GUESS

The answer is A: The Earth spins, so each place turns away from the Sun.

The Earth spins. Your place turns toward the Sun, then away from it. When it faces away, it is night.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. What gives us day and night?

   A The Sun goes round the Earth each day

   B The Moon covers the Sun each night

   C The Earth spins

   Answer at the back of the book.

2. Which half of the Earth has night?

   A The half facing the Sun

   B The half facing away from the Sun

   C The half nearest the Moon

   Answer at the back of the book.

3. In the lamp model, what does the ball stand for?

   A The Earth

   B The Sun

   C The Moon

   Answer at the back of the book.

4. The Earth makes one spin in about 24 hours. How many hours do 2 spins take?

   Answer at the back of the book.

5. **From an earlier chapter**

   Which one is a star that makes its own light?

   A The Earth

   B The Moon

   C The Sun

   Answer at the back of the book.

6. Draw the Earth with the Sun on the left. Show the day half and the night half.

   Answer at the back of the book.

7. It is night at your place. Where is the Sun?

   A The Sun has gone out for the night.

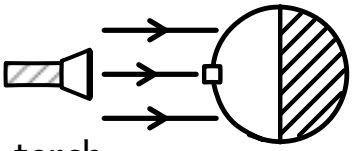
   B The Sun has gone round to the other side of the Earth.

   C The Moon is covering the Sun.

   D The Sun is shining on the other half of the Earth.

   Answer at the back of the book.

8. Hana has a mark on the lit half of the ball. She turns the ball slowly, one whole turn. The lamp stays still. What does the mark do?



mark on the lit side

   A It stays in the light all the time.

   B It goes into the dark and stays there.

   C It goes dark only if the lamp moves away.

   D It goes into the dark, then comes back into the light.

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

The Earth spins once in about 24 hours. The half facing the Sun has day. The half facing away has night. The Sun does not go away. Your place turns.

Draw: Draw the Sun and the Earth. Shade the half away from the Sun. Write day and night.

S2.9.3 CHAPTER 3

The Sun seems to move

Why does the Sun seem to cross the sky?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** The Sun rises in the west and sets in the east.
- ☐ **B** The Sun goes round the Earth every day.
- ☐ **C** The Earth turns, so the Sun seems to cross the sky.

IF THIS FEELS HARD, READ THIS FIRST

- Level 2, Earth, Sun and Moon, S2.9.2. The Earth spins. That gives us day and night.

BY THE END YOU CAN

- Explain why the Sun seems to cross the sky east to west
- Find east and west with a stick and two shadow marks

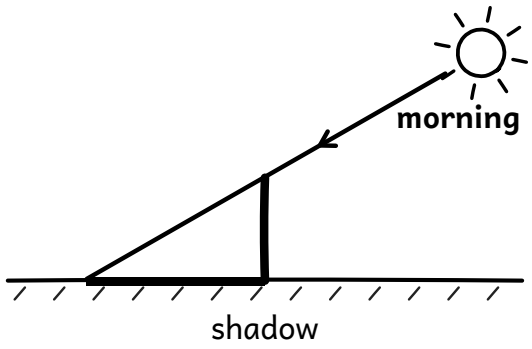
Watch the shadows on the ground through a day. Early in the day, they are long. At midday, they are short. Late in the day, they are long again.

Be safe. Never look at the Sun to see where it is. Not for a moment. Not through glass, sunglasses, cloth, a tube or a phone camera. Not in a mirror. Watch shadows on the ground instead.

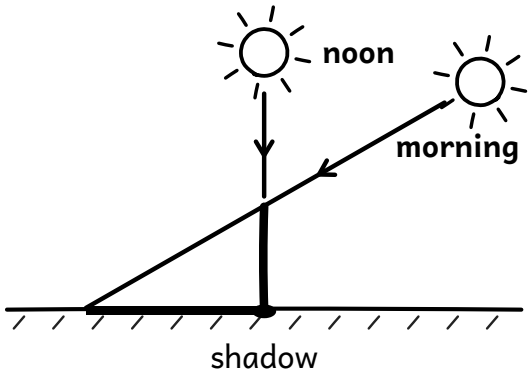
Long shadows mean the Sun is low. Short shadows mean the Sun is high. So the Sun climbs, and then it sinks.

DRAW IT FIRST

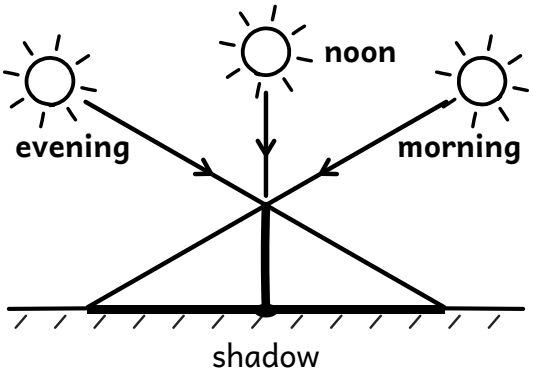
Draw a stick and its shadow through the day



1 Draw a stick. East is on the right. Draw the Sun low on the right. Draw a long shadow on the left. Write morning.



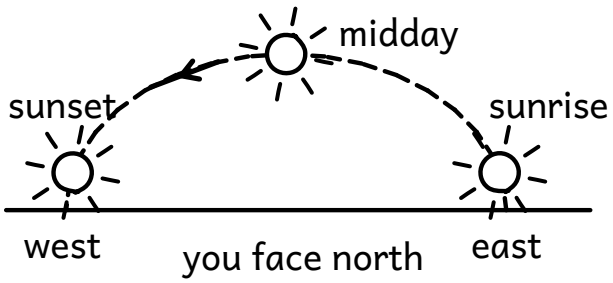
2 Draw the Sun high above. Draw a short shadow at the foot. Write noon.



3 Draw the Sun low on the left. Draw a long shadow on the right. Write evening.

Almost everywhere on Earth, the Sun rises roughly in the **east**. It crosses the sky. It sets roughly in the **west**.

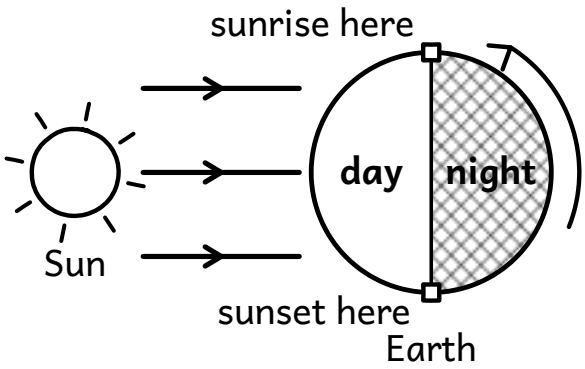
Most days it rises to the north or south of east. Roughly east is good enough to find your way.



Here you face north. If you face south, east is on your left.

Where the Sun stands at midday depends on your place. Far north of the equator, it stands in the south. Far south of the equator, it stands in the north. Near the equator, it can be almost overhead.

The Sun is not really crossing the sky. The Earth is turning. It turns toward the east. You turn with it.



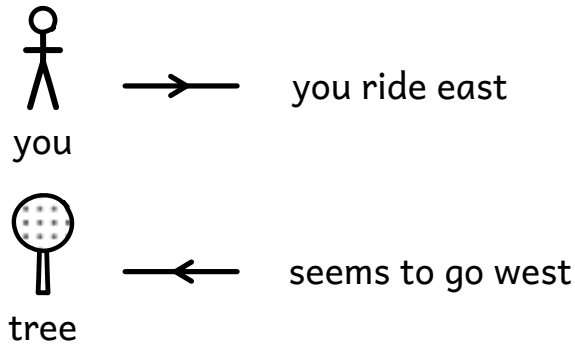
seen from above the North Pole

Seen from above the North Pole. The Earth turns. A place at the top turns into the light. A place at the bottom turns into the dark. Not to size.

Think of a bus. You ride east. A tree by the road is still. But the tree seems to go back, toward the west.

SEE IT THREE WAYS

As a picture



In words

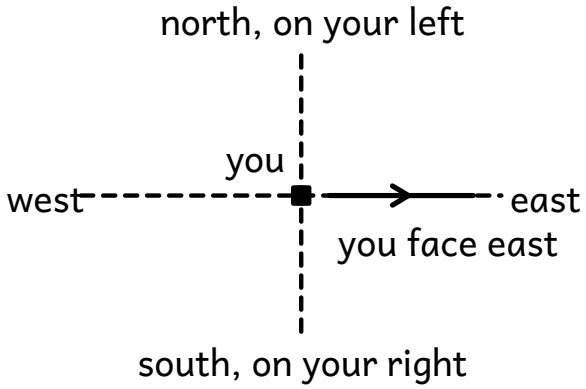
On a bus, you ride east. The tree seems to go west. The Earth turns east, so the Sun seems to go west.

In every place, the Sun seems to move from east to west.

A shadow points away from the Sun. As the Sun seems to move west, the shadow tip moves east.

So a stick can find east and west for you. You need no compass.

Two more directions help. Face east. **North** is on your left. **South** is on your right.



Face east. North is on your left. South is on your right.

TRY IT

Find east and west with a stick

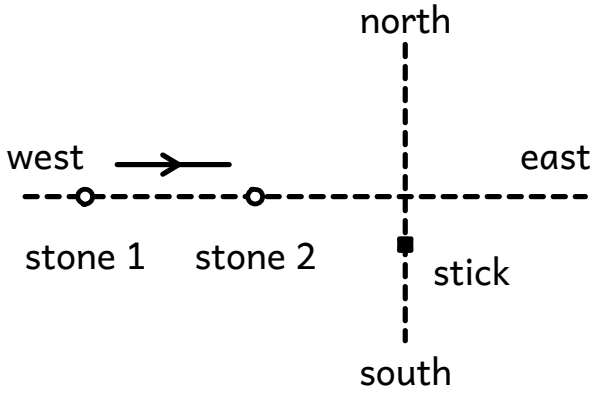
You need: a straight stick, as long as your arm, two stones, flat ground in the sun, with no shade, a sunny morning or afternoon, a clock, or a task that takes 20 minutes.

Be safe: Never look up at the Sun to check. Look only at the shadow on the ground. Wash your hands after you touch soil.

1. Push the stick upright into the ground. Check that it does not lean.
2. Look at its shadow on the ground. Put a stone at the tip of the shadow. Call it stone 1.
3. Wait about 20 minutes. Do not look at the Sun. The shadow moves.
4. Put the second stone at the new tip of the shadow. Call it stone 2.
5. Stand on the line between the stones, in the middle.
6. Turn so stone 1 is on your left. Stone 2 must be on your right.

What you will see: Stone 1 is west. Stone 2 is east. The line between the stones runs east and west. You now face roughly north. South is behind you. The stones need not line up with the stick. Only the line between them counts. The stones may lie north or south of the stick. It depends on where you live and the time of year.

If you cannot try it, this is what happens.



Now draw a line through the stick, across the stone line. Make the lines meet at a right angle. A right angle is a square corner, like on a book. That line through the stick runs north and south.

A WRONG IDEA MANY PEOPLE HAVE

~~The Sun goes round the Earth every day.~~

Why it feels right: You see the Sun climb, cross and sink. You feel nothing move.

The test that breaks it: Ride in a smooth bus, cart or train. Look at a tree beside the road. The tree seems to go back. It is still. Or stand in a room and turn slowly. The lamp seems to swing past. It is you who move.

What is true: The Earth turns. We turn with it. So the Sun seems to move. It does not go round us each day.

KEY WORDS

east
the direction where the Sun seems to rise. The Earth turns toward the east.

west
the direction where the Sun seems to set.

north
the direction on your left when you face east.

south
the direction on your right when you face east.

BACK TO YOUR GUESS

The answer is C: The Earth turns, so the Sun seems to cross the sky.

The Earth turns toward the east. So the Sun seems to rise in the east. It seems to set in the west.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Which way does the Sun seem to move across the sky?

   A From east to west

   B From west to east

   C From north to south

   Answer at the back of the book.

2. Why does the Sun seem to cross the sky?

   A The Sun goes round the Earth every day.

   B The Earth turns.

   C The sky turns while the Earth stands still.

   Answer at the back of the book.

3. Kofi marks the tip of a shadow with a stone. Twenty minutes later he marks it again. Which stone is west?

   A The second stone

   B Neither. The stones do not show direction.

   C The first stone

   Answer at the back of the book.

4. You stand between the stones. Stone 1 (west) is on your left. Stone 2 (east) is on your right. Which way do you face?

   A North

   B South

   C East

   Answer at the back of the book.

5. **From an earlier chapter**

   Amina holds a ball by a lamp and turns it. Her mark goes from the lit side to the dark side. What does the dark side stand for?

   A Day

   B Night

   C The Moon

   Answer at the back of the book.

6. Draw a stick with its shadow in the morning. Draw it again in the evening. Write which way each shadow points.

   Answer at the back of the book.

7. Ravi marks the tip of a shadow early, at midday and late. When is the shadow longest?

   A At midday, when the Sun is strongest

   B At night, when it is dark

   C It is the same length all day

   D Early and late in the day, when the Sun is low

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

The Earth turns toward the east. So the Sun seems to rise in the east. It seems to set in the west. A shadow stick finds them. Stone 1 is west. Stone 2 is east.

Draw: Draw a stick, two stones and a dashed line through them. Write west and east.

S2.9.4 CHAPTER 4

A year: going round the Sun

What is a year? Why does a year sometimes have an extra day?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** A year is how long the Sun takes to cross the sky.
- ☐ **B** A year is one trip of the Earth round the Sun.
- ☐ **C** A year is one trip of the Moon round the Earth.

IF THIS FEELS HARD, READ THIS FIRST

- Level 2, Earth, Sun and Moon, S2.9.2. One spin of the Earth is one day.

BY THE END YOU CAN

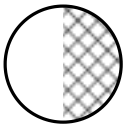
- Explain the Earth takes about 365 days to go round the Sun
- Explain why every fourth year has an extra day
- Explain that distance from the Sun does not make seasons

You know that one spin of the Earth makes a day. But the Earth also travels. It moves round the Sun in a big circle.

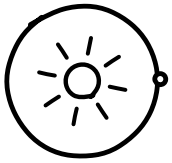
Be safe. Never look at the Sun. Not for a moment. Not through glass, sunglasses, cloth, a tube or a phone camera. Not in a mirror. Look only at shadows and marks on the ground or on paper.

An **orbit** is the path of one thing round another. The Earth moves round the Sun in an orbit.

One trip round the Sun is one **year**.



one spin
= 1 day

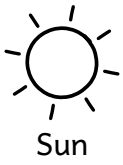


one trip
= 1 year
not to size

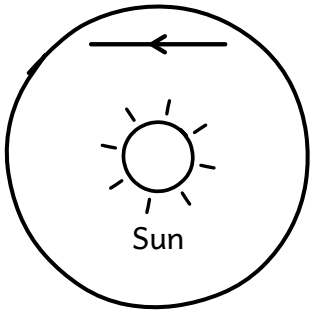
One spin of the Earth is a day. One trip round the Sun is a year.

DRAW IT FIRST

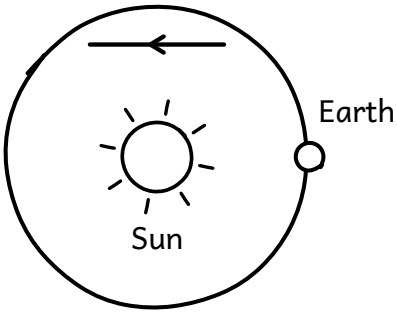
Draw the Earth going round the Sun



1 Draw the Sun in the middle of the page. Write Sun.



2 Draw a big ring round the Sun for the path. Add an arrow along it.



one trip = one year

3 Draw a small ball on the ring. Write Earth. Write one trip = one year.

This picture is not to size. The real path is much bigger.

The Earth moves very fast. But it moves smoothly, so you cannot feel it.

The trip takes about 365 and $^1/_4$ days. That is a year.

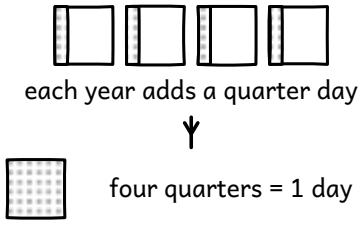
A calendar uses whole days. A calendar year has 365 days. The extra quarter of a day does not fit.

A quarter of a day is about 6 hours. Each year, the calendar is 6 hours short.

The spare quarters add up. Four quarters make one whole day. After four years, we add one extra day.

SEE IT THREE WAYS

As a picture



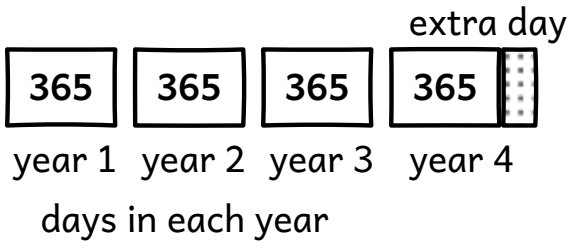
In words

Each year is a quarter of a day longer than the calendar. Four quarters make one whole day. So we add a day almost every fourth year.

In symbols

1 year = 365 and $^{1}/_{4}$ days. 4 × $^{1}/_{4}$ = 1 day.

A **leap year** has 366 days. Almost every fourth year is a leap year. All the other years have 365 days.



In a leap year, the extra day makes 366 days.

TRY IT

Add up the quarter days

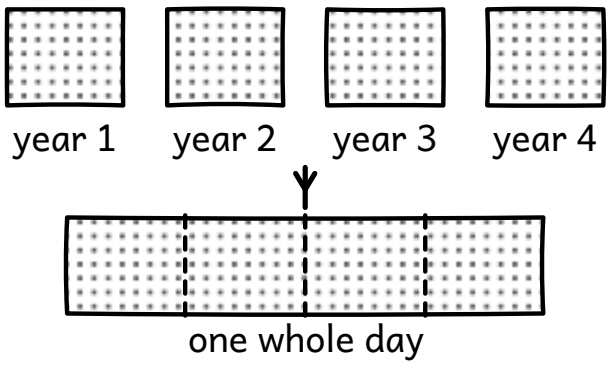
You need: a sheet of paper, a pen.

Be safe: Tear the paper. Do not use scissors. Never look at the Sun.

1. Fold the paper in half. Fold it in half again the same way. Open it out.
2. Tear the sheet along the folds. You have four equal pieces.
3. Write year 1 to year 4, one on each piece.
4. Each piece is the quarter day that one year leaves over.
5. Put the four pieces side by side to make the whole sheet.

What you will see: One piece is a quarter of the sheet. Four pieces make the whole sheet. In the same way, four spare quarter days make one whole day.

If you cannot try it, this is what happens.



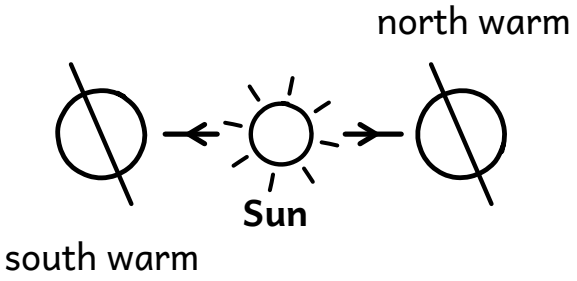
The year also brings **seasons**. A season is a part of the year with its own weather.

Many places have a warm season and a cold season. Near the equator there is little winter or summer.

The Earth leans a little to one side. It goes round the Sun. It always leans the same way.

So for part of the year the north leans toward the Sun. For the rest of the year the south leans toward it.

The half that leans toward the Sun has its warm season.



not to size

The Earth always leans the same way. On one side of its path the north leans toward the Sun. Half a year later the south does. Not to size.

A WRONG IDEA MANY PEOPLE HAVE

~~Every year has exactly 365 days.~~

Why it feels right: A calendar has 365 days, and most years do too.

The test that breaks it: Look at the calendars of four years in a row. Count their days. Almost always, three have 365 and one has 366. The paper pieces show why.

What is true: A year is about 365 and a quarter days. So almost every fourth year has an extra day, a leap year.

A WRONG IDEA MANY PEOPLE HAVE

~~Summer comes when the Earth is nearer the Sun.~~

Why it feels right: A fire feels hotter when you stand nearer to it.

The test that breaks it: The north is warm while the south is cold. Both halves of the Earth are the same distance from the Sun.

What is true: The Earth leans. The half that leans toward the Sun is warmer. Near the equator there is little winter or summer.

KEY WORDS

orbit
the path of one thing round another.

year
one trip of the Earth round the Sun. It takes about 365 and a quarter days.

leap year
a year with 366 days. It comes almost every fourth year.

seasons
parts of the year with their own weather.

BACK TO YOUR GUESS

The answer is B: A year is one trip of the Earth round the Sun.

A year is one trip of the Earth round the Sun. It takes about 365 and $^1/_4$ days. The quarters add up to an extra day.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. What is a year?

   A One trip of the Earth round the Sun

   B One spin of the Earth

   C One trip of the Moon round the Earth

   Answer at the back of the book.

2. How many days is one trip of the Earth round the Sun?

   A About 30 days

   B About 24 days

   C About 365 days

   Answer at the back of the book.

3. Count the days in 4 years in a row. Three years have 365 days. One leap year has 366 days. How many days in all?

   Answer at the back of the book.

4. Each year, the calendar is about 6 hours short. How many hours short is it after 4 years?

   Answer at the back of the book.

5. **From an earlier chapter**

   Which way does the Sun seem to move across the sky?

   A From west to east

   B From east to west

   C It does not seem to move.

   Answer at the back of the book.

6. Draw the Sun and the Earth on its path. Write one year beside the path.

   Answer at the back of the book.

7. Why does almost every fourth year have an extra day?

   A The Earth goes round the Sun faster in some years.

   B Long ago, people made a mistake in the calendar.

   C A trip takes 366 days, so every year needs an extra day.

   D Each year leaves a quarter of a day. Four of them make a whole day.

   Answer at the back of the book.

8. Why do some places have a warm season and a cold season?

   A The Earth moves nearer the Sun in the warm season.

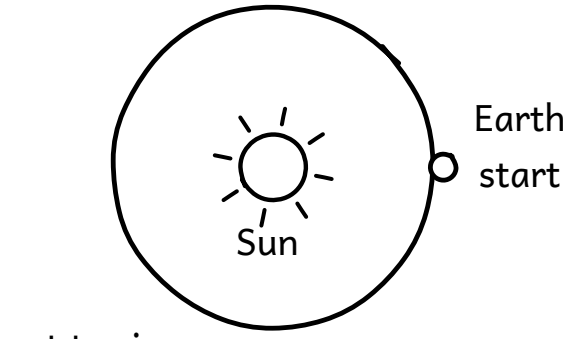
   B The Sun gets hotter and cooler through the year.

   C The half facing the Sun has the warm season.

   D The Earth leans. Each half leans toward the Sun in turn.

   Answer at the back of the book.

9. The picture shows the Earth at the start of its trip. Where is it one year later?



not to size

A Half way round the path

B It has gone round the Sun 365 times

C Back at the start

Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

One trip round the Sun takes about 365 and a quarter days. That is a year. The spare quarters add up to one day. So almost every fourth year has 366 days.

Draw: Draw the Sun and a ring round it. Put the Earth on the ring. Write one year.

S2.9.5 CHAPTER 5

The Moon goes round the Earth

Where does the Moon go, and why does it shine?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** The Moon makes its own light and stays still.
- ☐ **B** The Moon goes round the Earth and shines with sunlight.
- ☐ **C** The Moon is a small Sun that goes away by day.

BY THE END YOU CAN

- Explain that the Moon goes round the Earth about once a month
- Explain that the Moon shines because it reflects sunlight

The Moon is a ball of rock. It is much smaller than the Earth. It has no air.

The Moon is not still. It goes round the Earth. The path of one thing round another is its **orbit**.

The Moon goes round the Earth once in about a **month**. Full Moon to full Moon takes about 29 and a half days. Our word month comes from Moon.

Be safe. Never look at the Sun, not even for a moment. Not through glass, sunglasses, cloth, a tube or a phone camera. Not in a mirror. It can hurt your eyes. Look only at shadows and marks on the ground or on paper.

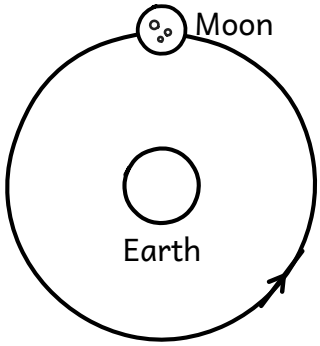
The Moon makes no light of its own. Sunlight lands on it. Some of it bounces off. That bounced light is what you see. We say the Moon **reflects** sunlight.

DRAW IT FIRST

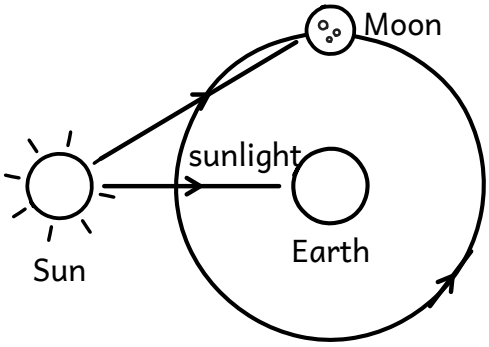
Draw the Moon on its orbit



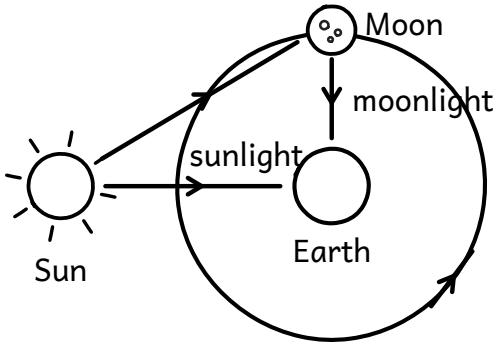
1 Draw the Earth in the middle. Write Earth.



2 Draw a ring round it. Put the Moon on the ring. Write Moon. Add an arrow on the ring.



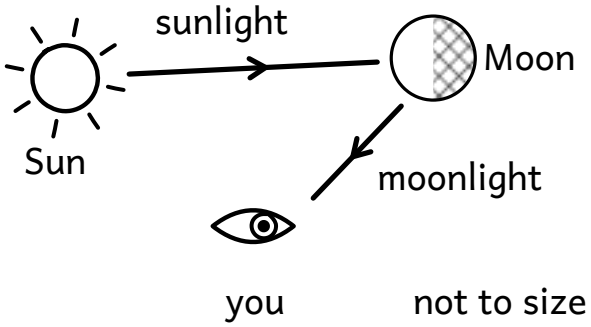
3 Draw the Sun on the left. Draw arrows of sunlight to the Earth and the Moon.



4 Draw an arrow from the Moon to the Earth. Write moonlight.

The picture is not to scale. In real life the Moon is far from the Earth. The Sun is much further away.

The Sun always lights the half of the Moon that faces it. The Moon is like a pale stone in a torch beam.

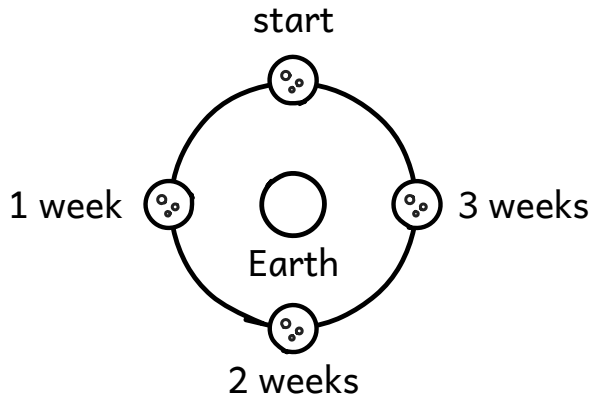


Sunlight bounces off the Moon's lit side and reaches your eye. Not to size.

The Moon turns as it goes round. So the same side always faces us. From the Earth we never see the other side.

SEE IT THREE WAYS

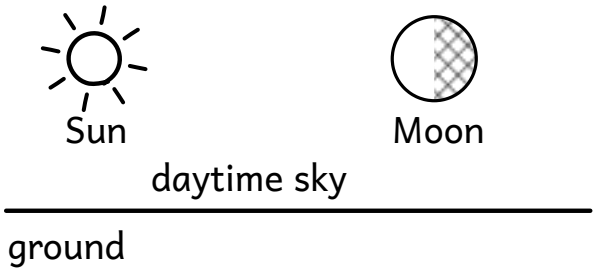
As a picture



In words

Start at a full Moon. Each week the Moon goes about a quarter of the way round. After about 29 and a half days it is full again.

You can often see the Moon in the day. The sky is bright then, so the Moon looks pale.



A half Moon in the day sky. Its lit side faces the Sun. Never look at the Sun.

TRY IT

Be the Earth, and let a friend be the Moon

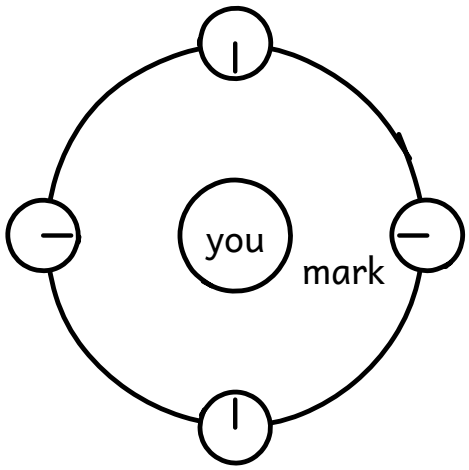
You need: a friend, a ball, or a stone wrapped in paper, a pen, a clear floor.

Be safe: Walk slowly and keep the floor clear. Do this indoors, away from the Sun.

1. Draw a mark on the ball. This mark is the side of the Moon that faces us.
2. Stand in the middle of the floor. You are the Earth.
3. Your friend holds the ball. The mark must always face you.
4. Your friend walks slowly round you in a circle. The mark keeps facing you.
5. Watch the ball. Can you ever see the back of it?

What you will see: You never see the back of the ball. Your friend turns round once while walking round you once. The Moon does the same. So we always see the same side of the Moon.

If you cannot try it, this is what happens.



A WRONG IDEA MANY PEOPLE HAVE

~~The Moon comes out only at night.~~

Why it feels right: We notice the Moon most when the sky is dark. It looks brightest then.

The test that breaks it: For a week, look at the morning and afternoon sky. Look away from the Sun. On some of those days you will see a pale Moon. Never look near the Sun to find it.

What is true: The Moon is in the sky by day too. The daylight makes it look pale.

KEY WORDS

orbit
the path of one thing round another.

month
about the time the Moon takes to go round the Earth once.

reflect
to send light back.

BACK TO YOUR GUESS

The answer is B: The Moon goes round the Earth and shines with sunlight.

The Moon goes round the Earth about once a month. It makes no light. It shines because sunlight bounces off it.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. How long does the Moon take to go round the Earth once?

   A About a month

   B About a day

   C About a year

   Answer at the back of the book.

2. Full Moon to full Moon takes about 29 and a half days. How many days is that twice?

   Answer at the back of the book.

3. Why does the Moon shine?

   A It makes its own light.

   B It is a small Sun.

   C Sunlight bounces off it.

   Answer at the back of the book.

4. Ravi sees a pale Moon in the afternoon sky. What does this show?

   A The Moon is in the sky by day too.

   B The Moon has come out too early.

   C The Moon has lost some of its own light.

   Answer at the back of the book.

5. **From an earlier chapter**

   Which half of the Earth has day?

   A The half that faces the Moon

   B The half where the Sun has gone behind the hills

   C The half that faces the Sun

   Answer at the back of the book.

6. Draw the Sun, the Earth and the Moon. Add arrows to show how moonlight reaches the Earth.

   Answer at the back of the book.

7. Why do we always see the same side of the Moon?

   A The Moon does not turn at all as it goes round.

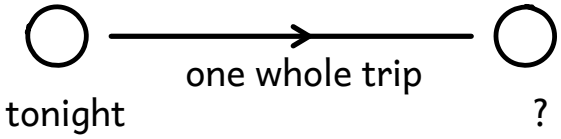
   B The far side of the Moon is always dark.

   C The Moon is flat, with only one side.

   D The Moon turns once as it goes round the Earth once.

Answer at the back of the book.

8. Amina sees a full Moon tonight. When will she see the next full Moon?



   A In about a week

   B In about a month

   C In about a year

   D In about half a month

Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

The Moon goes round the Earth once in about a month. It makes no light of its own. It shines because sunlight bounces off it. The same side always faces us.

Draw: Draw the Earth with a ring round it. Put the Moon on the ring. Draw the Sun and an arrow to the Moon.

S2.9.6 CHAPTER 6

Phases of the Moon

Why does the Moon change shape?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** The Earth's shadow covers part of it.
- ☐ **B** The Moon really grows and shrinks.
- ☐ **C** We see more or less of its lit half.

BY THE END YOU CAN

- Model the phases of the Moon with a ball and a lamp
- Draw the Moon each night for two weeks and name the phases
- Explain why the Moon looks upside down in the other hemisphere

Some nights the Moon is a thin curve. A week later it is a half circle. Later it is a full circle. How can this be?

The Moon does not change. It is always a ball.

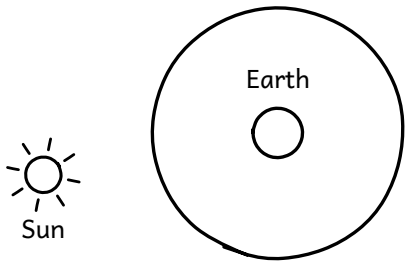
The Sun always lights half of the Moon. A torch lights half of a ball in the same way.

The Moon goes round the Earth. So each night we look at it from a new place. We see more or less of the lit half.

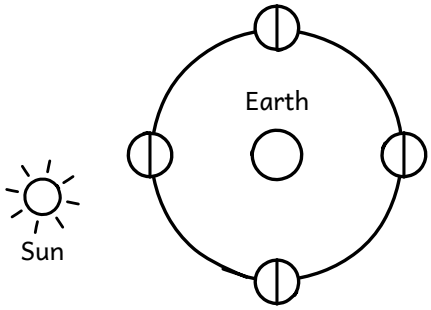
Be safe. Never look at the Sun, not even for a moment. Not through glass, sunglasses, cloth, a tube or a phone camera. Not in a mirror. To find a thin Moon, wait until the Sun has fully set.

DRAW IT FIRST

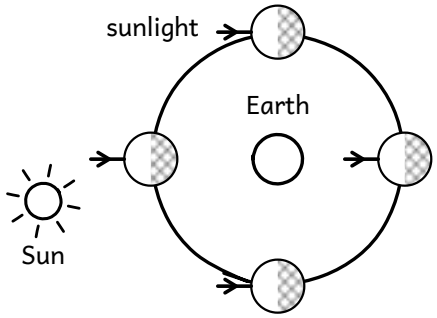
Draw why the Moon changes shape



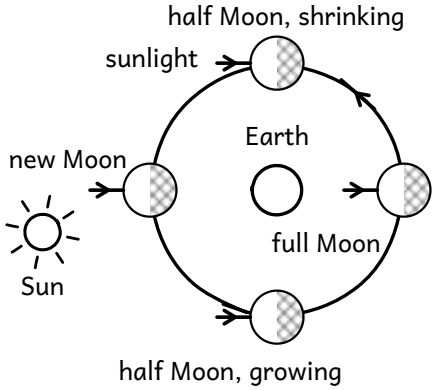
1 Draw the Sun on the left and the Earth in the middle. Draw a ring round the Earth.



2 Draw the Moon in four places on the ring. Draw a line down the middle of each.



3 Draw sunlight reaching each Moon from the left. Shade the half that faces away from the Sun.



4 Write each name: new, half growing, full, half shrinking. Add an arrow on the ring.

Look at the Moon on the left. It is between the Earth and the Sun. Its lit half faces the Sun. We see the dark half. We cannot see this Moon. It is a **new Moon**.

The Moon on the right is far from the Sun. The Earth is between them. We see its whole lit half. It is a **full Moon**.

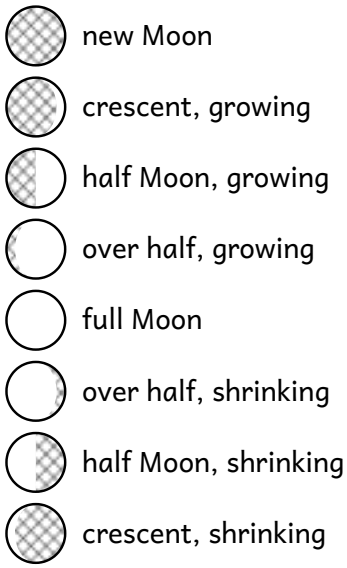
At the top and bottom the Moon looks half lit. Between new Moon and half Moon, we see a thin curve. A thin curve is a **crescent**.

The shape we see each night is a **phase**. The phases go round and round.

SEE IT THREE WAYS

As a picture

north of the equator



In words

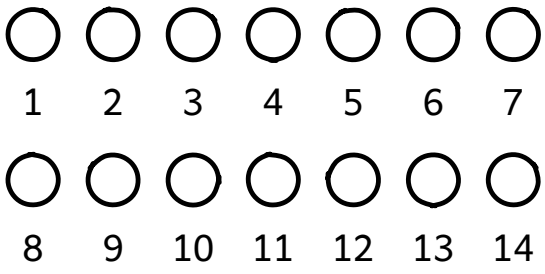
The Moon grows from new to full in about two weeks. Then it shrinks back to new in about two more.

Make a Moon diary. Start on the first evening you can see a thin Moon.

Look at the Moon at about the same time each clear evening. Draw it in a circle. Shade the dark part. Do this for two weeks.

If clouds hide the Moon, leave that circle empty. After full Moon, it rises later each night. Look a little later.

Write the name under each drawing. Use new Moon, crescent, half Moon, over half and full Moon.



One page of a Moon diary. Each circle is one evening.

TRY IT

Make the phases with a ball and a torch

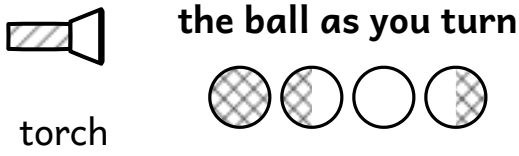
You need: a torch, a pale ball, or a stone wrapped in white paper, a room you can make dark, a shelf or chair for the torch.

Be safe: Never shine the torch into anyone's eyes. Never look at the Sun. Do this indoors with a torch only.

1. Stand the torch on a shelf and switch it on. Make the room dark.
2. Stand a few steps from the torch. Hold the ball high at arm's length.
3. Face the torch. Look at the ball. The lit side faces away from you.
4. Turn slowly to your left. Stop at each quarter turn.
5. At each stop, draw the lit part in a circle.

What you will see: The lit part of the ball changes as you turn. First you see a dark ball. Then half is lit. Then the whole near side is lit. Then half again. The torch always lights half of the ball.

If you cannot try it, this is what happens.



People in the north and in the south see the same Moon. But they see it turned round.

North and south are opposite ends of the Earth. People there have their heads pointing opposite ways. So they see the Moon turned half way round.

In the north, a growing Moon is lit on the right. In the south, it is lit on the left.

north of the equator



south of the equator



The same phases, seen from the north and the south.

Near the equator, a thin Moon can lie on its back. It looks like a boat.

Turn a picture of the Moon upside down. You see the Moon as people in the other half see it.

A WRONG IDEA MANY PEOPLE HAVE

~~**The phases of the Moon are the Earth's shadow on the Moon.**~~

Why it feels right: The dark part of the Moon looks like a shadow.

The test that breaks it: In the ball and torch test, you hold the ball high. Your head makes no shadow on it. The ball still goes through every phase. So no shadow is needed.

What is true: The Sun always lights half of the Moon. We see more or less of the lit half. The Earth's shadow falls on the Moon only in an eclipse.

KEY WORDS

phase
the shape of the lit part of the Moon that we see.

new Moon
the Moon between us and the Sun. Its lit half faces away from us.

full Moon
the Moon on the far side of the Earth. We see its whole lit half.

crescent
a thin curved shape.

BACK TO YOUR GUESS

The answer is C: We see more or less of its lit half.

The Moon is always a ball. The Sun lights half of it. We see more or less of that half.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. What makes the Moon change shape?

   A We see more or less of its lit half.

   B The Earth's shadow covers part of it.

   C The Moon grows and shrinks.

   Answer at the back of the book.

2. Where is the Moon at full Moon?

   A Between the Earth and the Sun

   B On the far side of the Earth from the Sun

   C In the Earth's shadow

   Answer at the back of the book.

3. Ana lives far south of the equator. The Moon is growing towards full. Which side is lit?

   A The left side

   B The right side

   C The whole Moon

   Answer at the back of the book.

4. A new Moon is on day 0. New Moon to new Moon takes 29 and a half days. About which day is the full Moon?

   Answer at the back of the book.

5. **From an earlier chapter**

   The Moon shines. Where does its light come from?

   A The Moon itself

   B The Sun

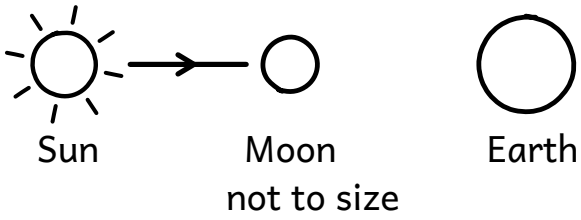
   C The Earth

   Answer at the back of the book.

6. Draw the Moon you saw last. Write its name.

   Answer at the back of the book.

7. The picture shows the Moon between the Sun and the Earth. What do we see from the Earth?



   A A full Moon

   B A half Moon

   C A crescent

   D A new Moon. We see its dark half.

   Answer at the back of the book.

8. After a full Moon, what do we see on later nights?

   A More and more of the Moon, so it grows bigger than full

   B A full Moon for a whole month

   C The Moon goes dark at once

   D Less and less of the lit half, night after night

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

The Moon is always a ball. The Sun lights half of it. As it goes round, we see more or less of that half. These are its phases. North and south see it upside down.

Draw: Draw the Sun, the Earth and a ring. Put the Moon on the ring in four places. Shade the half of each Moon that faces away from the Sun.

S2.9.7 CHAPTER 7

Eclipses

Why does the Sun sometimes go dark in the day?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** The Sun is switched off for a while.
- ☐ **B** The Moon passes in front of the Sun.
- ☐ **C** The Earth's shadow covers the Sun.

BY THE END YOU CAN

- Explain how the Moon blocks the Sun's light in an eclipse
- Make a pinhole viewer. Watch an eclipse facing away from the Sun
- Explain how the Earth's shadow causes an eclipse of the Moon

Sometimes the day goes dim. Sometimes the Moon turns dark red. Nothing is wrong. These are eclipses.

An **eclipse** is when one ball is in the shadow of another.

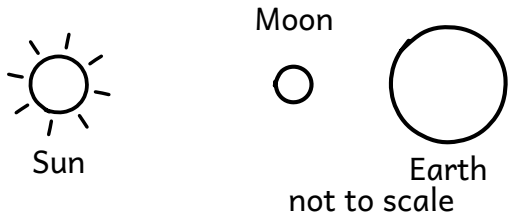
Be safe. Never look at the Sun, not even for a moment. Not through glass, sunglasses, cloth, a tube or a phone camera. Not in a mirror. This is true in an eclipse too. Look only at shadows and marks on the ground or on paper.

The Sun is the lamp. The Moon and the Earth are balls. Each ball has a shadow on the side away from the Sun.

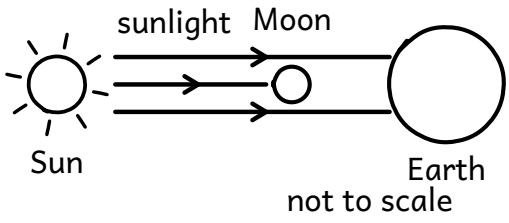
The Moon can pass between the Sun and the Earth. Then the Moon blocks the Sun's light. This is an **eclipse of the Sun**. Its other name is a solar eclipse.

DRAW IT FIRST

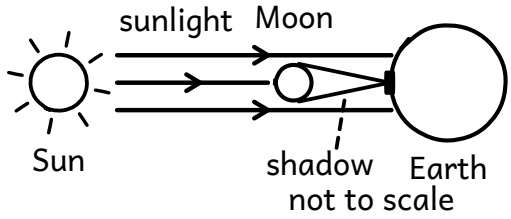
Draw an eclipse of the Sun



1 Draw the Sun, the Moon and the Earth in a line. Write their names.



2 Draw sunlight from the Sun. Let the middle arrow stop at the Moon.



3 Draw the Moon's shadow reaching the Earth. Shade the small patch where it lands.

The Moon's shadow is small. It touches only a narrow strip of the Earth.

People in the strip see the Sun fully covered. The day goes dim. People near the strip see part of the Sun covered. People far away see no change.

An eclipse of the Sun can happen only at new Moon. Then the Moon is between the Earth and the Sun.

The Moon is small, but it is near. The Sun is about 400 times as wide as the Moon. It is also about 400 times as far away. So they look the same size in the sky.

You can watch an eclipse of the Sun safely. Use a **pinhole viewer**. It makes a small picture of the Sun on paper. You look at the paper, never at the Sun.

TRY IT

Make a pinhole viewer

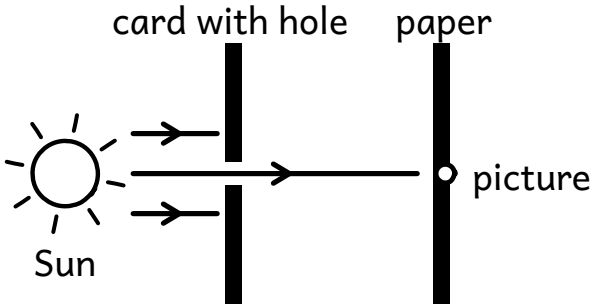
You need: a piece of card, about the size of a book, a sheet of paper, a pin, a grown up to help, a sunny day.

Be safe: Never look at the Sun. Not through the hole, not past the card. Look only at the paper. Only a grown up uses the pin.

1. A grown up pushes a pin through the middle of the card. The hole must be small and round.
2. Put the paper on the ground in the sunlight.
3. Stand with your back to the Sun. Never turn round to look at it.
4. Hold the card up over your shoulder, in the sunlight.
5. Let the card's shadow fall on the paper. Find the bright spot in it.
6. Move the card higher or lower. Stop when a small round picture shows.

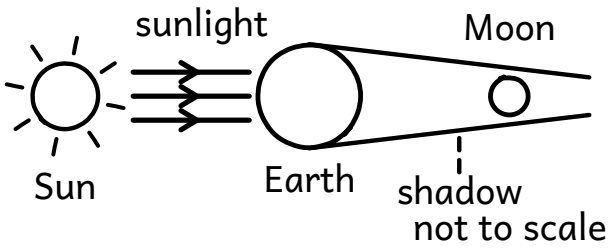
What you will see: A small round picture of the Sun shows on the paper. Hold the card higher and the picture grows bigger and dimmer. In an eclipse, the picture shows a bite out of the circle.

If you cannot try it, this is what happens.



Small gaps between leaves work like pinholes. Look at the ground under a tree. The bright round spots are pictures of the Sun. In an eclipse they show the bite.

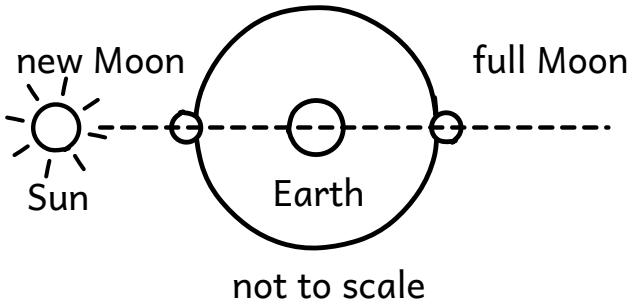
Sometimes the Earth is between the Sun and the Moon. The Earth's shadow falls on the Moon. This is an **eclipse of the Moon**. Its other name is a lunar eclipse.



The Earth's shadow falls on the Moon.

An eclipse of the Moon can happen only at full Moon. Then the Earth is between the Sun and the Moon.

Sun, Moon and Earth can line up at new or full Moon.

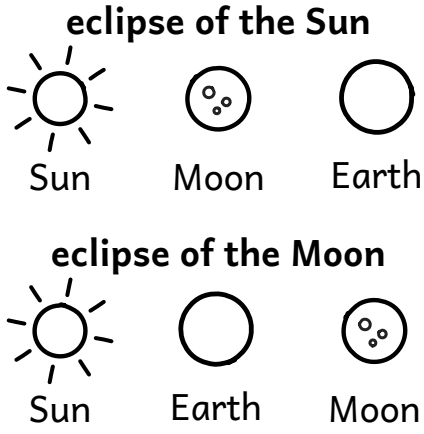


On the dashed line, an eclipse can happen. Not to scale.

Anyone on the night side of the Earth can see it. The Moon often turns dark red. It is safe to look at an eclipse of the Moon.

SEE IT THREE WAYS

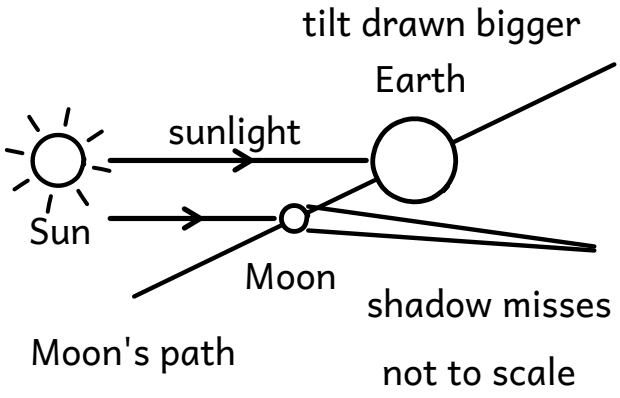
As a picture



In words

In an eclipse of the Sun, the Moon is in the middle. In an eclipse of the Moon, the Earth is in the middle.

Why is there no eclipse every month? The path of the Moon is tilted a little.



The tilt is drawn much bigger than it is. Most months the Moon is above or below the line. Its shadow misses the Earth.

A WRONG IDEA MANY PEOPLE HAVE

~~There is an eclipse at every new Moon and every full Moon.~~

Why it feels right: The Moon passes between the Sun and the Earth every month. It seems it must block the Sun.

The test that breaks it: Do this in a dark room. Use a torch for the Sun and a ball for the Earth. Hang a small stone on a thread for the Moon. Swing the stone round the ball in a flat circle. It passes in front of the torch each time. Its shadow falls on the ball. Now tilt the circle a little. The stone misses the line between the torch and the ball. No shadow reaches the ball.

What is true: The Moon's path is tilted a little. Most months it misses the line from the Sun to the Earth. So there is no eclipse.

KEY WORDS

eclipse
when one ball is in the shadow of another.

eclipse of the Sun
when the Moon blocks the Sun's light.

eclipse of the Moon
when the Earth's shadow falls on the Moon.

pinhole viewer
a card with a tiny hole. It shows a picture of the Sun on paper.

BACK TO YOUR GUESS

The answer is B: The Moon passes in front of the Sun.

The Moon passes between the Sun and the Earth. It blocks the Sun's light. This happens only at new Moon.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. At which phase can an eclipse of the Sun happen?

   A New Moon

   B Full Moon

   C Half Moon

   Answer at the back of the book.

2. What causes an eclipse of the Moon?

   A A cloud passes the Moon.

   B The Moon's own shadow falls on it.

   C The Earth's shadow falls on the Moon.

   Answer at the back of the book.

3. Tariq wants to watch an eclipse of the Sun. What is safe?

   A A pinhole viewer, with his back to the Sun

   B Looking at the Sun for a moment through sunglasses

   C Looking at the Sun through a phone camera

   Answer at the back of the book.

4. Who can see an eclipse of the Moon?

   A Only people in a narrow strip

   B Only people in the day

   C Anyone on the night side of the Earth

   Answer at the back of the book.

5. **From an earlier chapter**

   Why can we not see a new Moon?

   A The Earth's shadow covers it.

   B The Moon is gone.

   C Its lit half faces away from us.

   Answer at the back of the book.

6. Draw an eclipse of the Moon. Add the Earth's shadow.

   Answer at the back of the book.

7. Mei thinks every new Moon brings an eclipse of the Sun. Why does it not?

   A The Moon is too small to cover the Sun.

   B The Moon goes far away from the Earth most months.

   C The Earth's shadow covers the Moon at new Moon.

   D The Moon's path is tilted. Most months it misses the line to the Sun.

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

The Moon blocks the Sun at new Moon. That is an eclipse of the Sun. The Earth's shadow falls on the Moon at full Moon. That is an eclipse of the Moon. Never look at the Sun.

Draw: Draw the Sun, the Moon and the Earth in a line. Draw the Moon's shadow touching the Earth.

Key words, A to Z

Every key word in this book, what it means, and the chapter that teaches it.

crescent
a thin curved shape. S2.9.6

daytime
the time when your place faces the Sun. S2.9.2

east
the direction where the Sun seems to rise. The Earth turns toward the east. S2.9.3

eclipse
when one ball is in the shadow of another. S2.9.7

eclipse of the Moon
when the Earth's shadow falls on the Moon. S2.9.7

eclipse of the Sun
when the Moon blocks the Sun's light. S2.9.7

full Moon
the Moon on the far side of the Earth. We see its whole lit half. S2.9.6

gas
stuff like the air. You cannot hold it. S2.9.1

leap year
a year with 366 days. It comes almost every fourth year. S2.9.4

model
a small copy of something big. S2.9.1

month
about the time the Moon takes to go round the Earth once. S2.9.5

new Moon
the Moon between us and the Sun. Its lit half faces away from us. S2.9.6

night
the time when your place faces away from the Sun. S2.9.2

north
the direction on your left when you face east. S2.9.3

orbit
the path of one thing round another. S2.9.4, S2.9.5

phase
the shape of the lit part of the Moon that we see. S2.9.6

pinhole viewer
a card with a tiny hole. It shows a picture of the Sun on paper. S2.9.7

reflect
to send light back. S2.9.1, S2.9.5

seasons
parts of the year with their own weather. S2.9.4

south
the direction on your right when you face east. S2.9.3

spin
to turn round and round, like a wheel. S2.9.2

star
a huge ball of hot, glowing gas that makes its own light. The Sun is a star. S2.9.1

west
the direction where the Sun seems to set. S2.9.3

year
one trip of the Earth round the Sun. It takes about 365 and a quarter days. S2.9.4

Answers

S2.9.1. Sun, Earth and Moon

1. **A star: a huge ball of hot, glowing gas**

   The Sun is the star nearest to us. It makes its own light and heat.

   - **If you chose B:** The Earth and the Moon are balls of rock. The Sun is hot, glowing gas.
   - **If you chose C:** The Moon is a smaller ball of rock. It makes no light. The Sun is a star.

2. **The Sun lights the Moon**

   Sunlight lands on the Moon and lights it up. The Moon makes none.

   - **If you chose A:** The Moon is a ball of rock. It makes no light of its own.
   - **If you chose B:** The Earth is not a star. The light on the Moon comes from the Sun.

3. **109 cm, a little more than 1 m**

   109 times 1 cm is 109 cm. That is a little more than 1 m.

4. **3 mm**

   The Moon is a quarter as wide. 12 mm shared into 4 equal parts is 3 mm.

5. **No. The Sun is much bigger, but much farther away.**

   The Sun is about 400 times as wide as the Moon. It is also about 400 times as far away.

   - **If you chose A:** Far things look small. Your thumb can cover a far-off house.
   - **If you chose C:** The Moon is the smaller one. The Sun is about 400 times as wide.

6. **A big Sun, a smaller Earth, a tiny Moon. The Sun makes light.**

   The Sun is the biggest and it is a star. The Earth is smaller. The Moon is the smallest.

7. **Only the Sun is a star. The Earth and the Moon are balls of rock.**

   The Sun is a star and makes its own light. The Earth and the Moon are balls of rock.

   - **If you chose A:** The Moon shines only because sunlight lands on it. It is a ball of rock, not a star.
   - **If you chose B:** The Earth is not a star. Its daylight comes from the Sun.
   - **If you chose C:** The Sun is not rock. It is a huge ball of hot, glowing gas.

8. **30 cm from the pea**

   The Moon is about 30 Earths away from us. With a pea 1 cm wide, that is 30 cm.

   - **If you chose A:** That is where the Sun goes in the model. The Moon is much nearer than the Sun.
   - **If you chose B:** Drawings often put the Moon close to save room. The Moon is far away.
   - **If you chose C:** That is only 10 Earths away. The Moon is about 30 Earths away.

S2.9.2. Why we have day and night

1. **The Earth spins**

   The Earth spins. Each place turns toward the Sun, then away.

   - **If you chose A:** The lamp stayed still in your model. The ball turned. The Earth spins.
   - **If you chose B:** The Moon does not cover the Sun every night. Night is the half turned away from the Sun.

2. **The half facing away from the Sun**

   No sunlight reaches the half that faces away. There it is night.

   - **If you chose A:** The half facing the Sun is lit. It has day.
   - **If you chose C:** The Moon does not make night. The half turned away from the Sun has night.

3. **The Earth**

   The ball is the Earth. The lamp is the Sun. The mark is where you live.

   - **If you chose B:** The lamp is the Sun. It makes the light.
   - **If you chose C:** The Moon is not in this model. The ball is the Earth.

4. **48 hours**

   Each spin takes 24 hours. 2 times 24 is 48 hours. That is 2 days.

5. **The Sun**

   The Sun is a star, a huge ball of hot, glowing gas. It makes its own light.

   - **If you chose A:** The Earth is a ball of rock. It is not a star. Go to S2.9.1.
   - **If you chose B:** The Moon is a ball of rock. It makes no light of its own. Go to S2.9.1.

6. **A ball with the Sun on its left. The left half is day. The right half is shaded and is night.**

   The half that faces the Sun is lit. The half that faces away is dark.

7. **The Sun is shining on the other half of the Earth.**

   The Sun always lights one half of the Earth. At night your place is on the half turned away.

   - **If you chose A:** The Sun never goes out. It shines all the time. Your place has turned away from it.
   - **If you chose B:** In the model the lamp stayed still and the ball turned. The Earth turns. The Sun does not go round it.
   - **If you chose C:** The Moon hides the Sun only in an eclipse. That is rare and short. Night comes from the turning Earth.

8. **It goes into the dark, then comes back into the light.**

   The turning ball carries the mark out of the light and back. On the Earth, one spin is one day and one night.

   - **If you chose A:** The lamp lights only half of the ball. Turning the ball moves the mark away from the light.
   - **If you chose B:** One whole turn brings the mark back into the light. Your place does this every day.
   - **If you chose C:** The lamp stays still. The ball turns, so the mark leaves the lit half.

S2.9.3. The Sun seems to move

1. **From east to west**

   The Earth turns toward the east. So the Sun seems to go west.

   - **If you chose B:** The Earth turns toward the east. So the Sun seems to go the other way, toward the west.
   - **If you chose C:** The Sun seems to go from east to west. It does not go north to south.

2. **The Earth turns.**

   We turn with the Earth. So the Sun seems to move. A tree seems to move from a bus.

   - **If you chose A:** On a bus, the tree seems to move. It is you who move. The Earth turns.
   - **If you chose C:** The Earth is the one that spins. The Sun only seems to move.

3. **The first stone**

   The shadow tip moves east. So the first stone is the western one.

   - **If you chose A:** The Sun moves west, so the tip of the shadow moves east. The second stone is east.
   - **If you chose B:** They do. The line between the stones runs east and west.

4. **North**

   Facing north, west is on your left. East is on your right.

   - **If you chose B:** If you faced south, west would be on your right.
   - **If you chose C:** If you faced east, west would be behind you.

5. **Night**

   The half that faces away from the lamp is dark. On the Earth, that half has night.

   - **If you chose A:** The lit side is day. The dark side faces away from the Sun. Go to S2.9.2.
   - **If you chose C:** The Moon is not in the lamp model. The dark side is the night side. Go to S2.9.2.

6. **In the morning the shadow is long and points west. In the evening it is long and points east.**

   In the morning the Sun is in the east. So the shadow points west. In the evening it is the other way.

7. **Early and late in the day, when the Sun is low**

   A low Sun makes a long shadow. At midday the Sun is high, so the shadow is short.

   - **If you chose A:** At midday the Sun is high, so the shadow is short. A low Sun makes a long shadow.
   - **If you chose B:** A shadow needs light. At night there is no sunlight, so the Sun makes no shadow.
   - **If you chose C:** The shadow changes as the Sun climbs and sinks. Watch it through a day.

S2.9.4. A year: going round the Sun

1. **One trip of the Earth round the Sun**

   The Earth goes round the Sun once a year. The trip takes about 365 and a quarter days.

   - **If you chose B:** One spin of the Earth is a day. A year is a whole trip round the Sun. Go to S2.9.2.
   - **If you chose C:** The Moon goes round the Earth in about a month. A year is the Earth's trip round the Sun.

2. **About 365 days**

   The trip takes about 365 and a quarter days.

   - **If you chose A:** Thirty days is about one month. The Earth's trip round the Sun takes much longer.
   - **If you chose B:** The Earth spins once in about 24 hours. That is a day, not a year. Go to S2.9.2.

3. **1 461 days**

   3 times 365 is 1 095. Add 366 to get 1 461.

4. **24 hours, which is one whole day**

   4 times 6 hours is 24 hours. That is one whole day, so we add a leap day.

5. **From east to west**

   The Earth turns toward the east. So the Sun seems to go west.

   - **If you chose A:** The Earth turns toward the east. So the Sun seems to go west. Go to S2.9.3.
   - **If you chose C:** You can watch a shadow change through the day. The Sun seems to cross the sky. Go to S2.9.3.

6. **A Sun in the middle with a ring round it. A small Earth sits on the ring. The words one year are by the ring.**

   One trip of the Earth round the Sun is one year.

7. **Each year leaves a quarter of a day. Four of them make a whole day.**

   The calendar has 365 days. A trip takes a quarter of a day more. Four spare quarters make one day.

   - **If you chose A:** The Earth takes the same time every year. The trip takes about 365 and a quarter days.
   - **If you chose B:** It is no mistake. A trip takes about 365 and a quarter days. The calendar adds a day to keep up.
   - **If you chose C:** A trip takes 365 days and a quarter, not 366. Only after four years do the quarters make a day.

8. **The Earth leans. Each half leans toward the Sun in turn.**

   The half that leans toward the Sun is warmer. Half a year later, the other half leans toward it.

   - **If you chose A:** The north is warm while the south is cold. Both halves are the same distance from the Sun.
   - **If you chose B:** The Sun gives out about the same heat all year. The lean of the Earth changes how much each half gets.
   - **If you chose C:** The half facing the Sun has day. That changes every few hours. A season lasts months. It comes from the lean.

9. **Back at the start**

   One year is one whole trip round the Sun. At the end of it the Earth is back where it began.

   - **If you chose A:** Half way round takes about half a year. A whole year is a whole trip.
   - **If you chose B:** The Earth spins about 365 times in a year. It goes round the Sun only once. Go to S2.9.2.

S2.9.5. The Moon goes round the Earth

1. **About a month**

   Full Moon to full Moon takes about 29 and a half days. That is about a month.

   - **If you chose B:** A day is one spin of the Earth. The Moon takes much longer to go round. Go to S2.9.2.
   - **If you chose C:** A year is one trip of the Earth round the Sun. The Moon takes about a month. Go to S2.9.4.

2. **59 days**

   29 and a half days twice is 59 days.

3. **Sunlight bounces off it.**

   The Sun lights the Moon. The Moon sends some of the light back, so we see it.

   - **If you chose A:** The Moon makes no light. It is like a stone in a torch beam.
   - **If you chose B:** The Sun is a star that makes light. The Moon is a ball of rock. Go to S2.9.1.

4. **The Moon is in the sky by day too.**

   The Moon is in the day sky on many days. The bright sky makes it look pale.

   - **If you chose B:** The Moon does not come out. It is always going round the Earth. Sometimes it is in the day sky.
   - **If you chose C:** The Moon never made light of its own. Bright daylight makes the Moon look pale.

5. **The half that faces the Sun**

   The Sun lights one half of the Earth. That half has day. The other half has night.

   - **If you chose A:** The Moon makes no light. Day is the half of the Earth that the Sun lights. Go to S2.9.2.
   - **If you chose B:** Hills do not make night. The Earth turns away from the Sun. Go to S2.9.2.

6. **An arrow goes from the Sun to the Moon. A second arrow goes from the Moon to the Earth.**

   The Moon makes no light. It sends back some of the sunlight to the Earth.

7. **The Moon turns once as it goes round the Earth once.**

   The Moon turns just as fast as it goes round. So the same side always faces the Earth.

   - **If you chose A:** It does turn. Your friend turned once while walking once round you. The Moon does the same.
   - **If you chose B:** The Sun lights the far side too. We just never see it from the Earth.
   - **If you chose C:** The Moon is a ball. It has a far side that we cannot see from the Earth.

8. **In about a month**

   The next full Moon comes after one whole trip. The trip takes about a month.

   - **If you chose A:** That is about a quarter of the trip. A full Moon comes again after the whole trip.
   - **If you chose C:** A year is the Earth's trip round the Sun. The Moon goes round the Earth in about a month.
   - **If you chose D:** That is half way through the trip. A full Moon comes again after the whole trip.

S2.9.6. Phases of the Moon

1. **We see more or less of its lit half.**

   The Sun lights half of the Moon. The Moon goes round. We see a different amount of that half.

   - **If you chose B:** The Earth's shadow falls on the Moon only in an eclipse. The ball and torch test needs no shadow.
   - **If you chose C:** The Moon is always the same ball. Only the part we see is different.

2. **On the far side of the Earth from the Sun**

   From the Earth we see the whole lit half.

   - **If you chose A:** That is new Moon. The lit half faces away from us.
   - **If you chose C:** The Moon is in the Earth's shadow only in an eclipse. A full Moon is lit.

3. **The left side**

   People in the south see the Moon turned round. A growing Moon is lit on the left.

   - **If you chose B:** That is how it looks in the north. In the south the Moon is the other way up.
   - **If you chose C:** A growing Moon is not yet full. Only part of it is lit.

4. **About day 15**

   The full Moon is about half way round. Half of 29 and a half is nearly 15.

5. **The Sun**

   The Sun lights the Moon. The Moon reflects some of that light to us.

   - **If you chose A:** The Moon makes no light. It sends back sunlight. Go to S2.9.5.
   - **If you chose C:** The light comes from the Sun. The Moon only sends it back. Go to S2.9.5.

6. **A circle with the dark part shaded. A name: new Moon, crescent, half Moon, over half or full Moon.**

   The shape of the lit part gives the phase its name.

7. **A new Moon. We see its dark half.**

   The Sun lights the half of the Moon that faces the Sun. From the Earth we see the other half, which is dark.

   - **If you chose A:** At full Moon the Earth is between the Sun and the Moon. Here the Moon is between the Earth and the Sun.
   - **If you chose B:** A half Moon is off to the side. Here the Moon is in line with the Sun and the Earth.
   - **If you chose C:** A crescent shows when the Moon is just off the line. Here it is on the line.

8. **Less and less of the lit half, night after night**

   The Moon keeps going round. Each night we see less of its lit half, until new Moon.

   - **If you chose A:** A full Moon shows all of the lit half. There is no more to see. After that we see less.
   - **If you chose B:** The Moon looks full for only a night or two. Then we see less of its lit half.
   - **If you chose C:** The change is slow. Each night we see a little less of the lit half.

S2.9.7. Eclipses

1. **New Moon**

   At new Moon the Moon is between the Earth and the Sun. Then it can block the Sun.

   - **If you chose B:** At full Moon the Earth is between the Sun and the Moon. That can bring an eclipse of the Moon.
   - **If you chose C:** At half Moon the Moon is off to the side. It is not in a line with the Sun and the Earth. Go to S2.9.6.

2. **The Earth's shadow falls on the Moon.**

   The Earth is between the Sun and the Moon. Its shadow reaches out and covers the Moon.

   - **If you chose A:** A cloud is in our air. It cannot shade the Moon. The Earth's shadow does.
   - **If you chose B:** A ball cannot shade its own lit side. The Earth's shadow falls on the Moon.

3. **A pinhole viewer, with his back to the Sun**

   You look at a picture on paper. You never look at the Sun.

   - **If you chose B:** Sunglasses do not make the Sun safe. Even a moment can harm your eyes.
   - **If you chose C:** A phone camera is not safe. Never look at the Sun this way.

4. **Anyone on the night side of the Earth**

   The Moon is up for everyone on the night side. They can all see the shadow on it.

   - **If you chose A:** That is an eclipse of the Sun. The Earth's shadow is big enough to cover the whole Moon.
   - **If you chose B:** At full Moon the Moon is on the night side. People in the day cannot see it.

5. **Its lit half faces away from us.**

   At new Moon the Moon is between us and the Sun. We see the half that the Sun does not light.

   - **If you chose A:** The Earth's shadow falls on the Moon only in an eclipse. Go to S2.9.6.
   - **If you chose B:** The Moon is still there. We look at its dark half. Go to S2.9.6.

6. **The Earth is between the Sun and the Moon. Its shadow reaches the Moon.**

   The Earth is in the middle. Its shadow falls on the Moon.

7. **The Moon's path is tilted. Most months it misses the line to the Sun.**

   Most months the Moon is above or below the Sun-Earth line. Its shadow misses the Earth.

   - **If you chose A:** The Moon looks as wide as the Sun in the sky. When it is in line, it can cover the Sun.
   - **If you chose B:** The Moon stays near the Earth. It keeps going round it. The path is tilted.
   - **If you chose C:** The Earth's shadow reaches the Moon only at full Moon. At new Moon the Moon is between us and the Sun.

About this book

For learners who can read short sentences and draw the Moon they saw last. In many schools this fits children of about 8 to 10, and older learners can use it too. Activities use a torch or lamp, a ball, a stick, stones and card. Every chapter repeats one rule: never look at the Sun, not even through glass or a phone. A learner can work alone: every exercise has its answer and the reason for it.

Written and drawn by attnom. Edition 1.0, 2026-11-09.

This book is free. You may read it, print it, copy it and share it with anyone.

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