SPACE WEEK

Our Planet • Our Space • Our Time

Resource Book for Teachers

TOPIC: Earth in Space

BCO The Space For Science

Ireland esero

World Space Week IRELAND

Earth in Space Background

About Gravity

The Curious Minds Resource Investigating Gravity and Falling Objects (in Irish) has background information on gravity and how it can be taught in the primary classroom.

It is much more straightforward to describe the effects of gravity than to understand the origins of the force.

The Science Teacher Guidelines state:

> **Gravity**
> All objects attract one another. The force of attraction which an object exerts is in proportion to its mass. The Earth has a large mass, and so the force of attraction between it and other objects is big, and this force pulls objects to the Earth. This force is called the 'weight' of an object. The weight of an object is a measure of how much the Earth pulls on it. [page 110]
>
> But note:
>
> **Weight and mass**
> In the science curriculum document and in these guidelines no distinction is made between the terms mass and weight. The mass of an object is the amount of material or matter it contains; the weight of an object is the amount of force being exerted on it by the pull of gravity. Most children during the primary years will not have developed the ability to grasp the distinction between mass and weight, and therefore, for general classroom use, the term 'weight' is used in these guidelines. [page 18]

Learners will explore gravity and should come to appreciate that

1. It acts downward near the surface of the Earth.
2. It acts at a distance; an object does not need to be touching the Earth to feel the gravitational pull from the Earth.
3. It can act through objects.
4. It is a weak force; humans can jump off the surface of the planet, even though the force of the whole planet is pulling on them.
5. It acts at a very large distance. Gravity acts throughout the solar system and the Universe.

Learners may ask “what is gravity?” It was understood differently by Sir Isaac Newton and Albert Einstein.

> “The modern explanation for the gravitational force is based on Albert Einstein's general theory of relativity. According to Einstein, Newton's notion that gravity is due to a force that acts instantly, and at a distance, between objects with mass is wrong. There is no gravitational force. Rather, in Einstein's view, the gravitational force is a consequence of the geometry of space and time.
>
> The essential idea is that space is rather like an elastic medium that can be distorted or curved, and that this curvature is caused by the energy and momentum of matter and radiation.”

See: https://spark.iop.org/collections/gravity-and-space-physics-narrative-0 for an outline of these concepts for children aged 11 to 14.

See also:

Engineeers Week 2018 Gravity

Night Sky Network’s Gravity Buckets

ESA’s ISS Primary Education Kit, Chapter 1

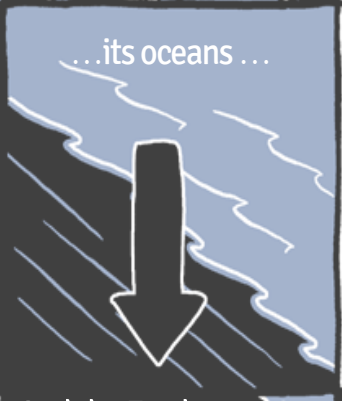
The reason we don't fall off Earth is because of gravity.

The first to establish the laws of gravity was Isaac Newton.

Earth's gravity doesn't make things fall down but fall towards the middle of the planet.

That goes for everything on the Earth, its skies ...

...its oceans ...

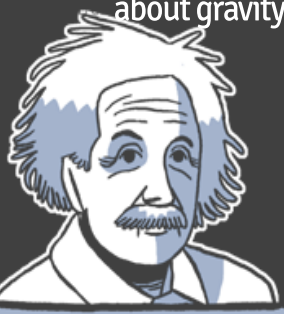


... its people.

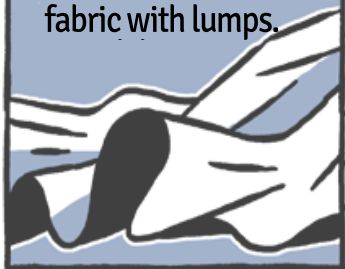
This force of attraction is stronger for larger objects.

And the Earth is a very large object !

Later, Albert Einstein solved another problem about gravity.



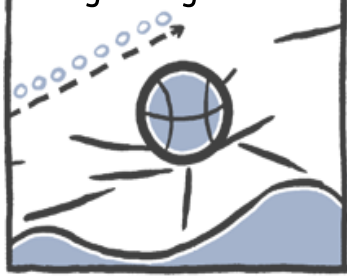
He said that space is not empty, or even flat. It is more like fabric with lumps.



Gravity is just objects rolling into dents (or around lumps).

A basketball plonked in a sheet will bend the fabric making a big dent.

If you roll a few marbles across the sheet, some will go straight across.



With enough speed, some marbles might make a complete circle.

And others will make contact with it.

SFI Curious Minds/ESERO Framework for Inquiry

Theme	Earth In Space
Curriculum	Science > Energy and Forces > Light: • discuss differences between day and night, light and shade • explore how shadows are formed. Science > Energy and Forces > Forces • come to appreciate that gravity is a force • become aware that objects have weight because of the pull of gravity Geography > Natural environments > Planet Earth in space • develop familiarity with the spherical nature of the Earth • identify the sun, the moon, stars • observe, describe and record the positions of the sun when rising and setting and the changing lengths of day and night during the seasons • investigate the relative lengths and directions of shadows and the intensity of sunlight at different times of the year • recognise that the Earth, its moon, the sun, other planets and their satellites are separate bodies and are parts of the solar system, develop a simple understanding of the interrelationship of these bodies, including day and night Skills Development: Observing, questioning, predicting, measuring, investigating and analysing. Maths: Record and Display data.

Engage

The Prompt	Wondering	Exploring
Earth in space image Video: Earthrise at https://youtu.be/1R5QqhPq1Ik JUICE mission flyby of the Moon and the Earth in August 2024: https://youtu.be/20i3cAZSnPY	What holds the Earth around the Sun? and the Moon around the Earth? -> gravity activities What holds people on the Earth? On the Moon? How much would you weigh on the Moon or on another planet? Why is the Earth only half lit up? How fast does the Earth turn? -> day and night activities How long does it take the Earth to go around the Sun? -> seasons activities How did they take that picture? Why were they going around the Moon?	What does Gravity Do? – holds the Earth around the Sun & affects the planets. View the Gravity Background video from Reel Life Science https://youtu.be/6fmT3ELckbA Young children can explore the activities of ESERO 8 "What Does Gravity Do?" & ESERO 28 "Feel Gravity." Modelling the effects of Gravity: Explore the concepts in ESERO 68, then build an inquiry investigation around one of the questions the learners have. See first investigation for an example.

Investigate: What pulls us? (from ESERO 68)

Starter Question	Predicting	Conducting the Investigation	Sharing: Interpreting the data / results
What happens to the speed of the orbiting person if the rope is pulled tighter?	Learners should predict how the speed of the person 'in orbit' changes if the rope is pulled with more force. They might refer to their exploration of this activity. They might explain what would happen if the rope was dropped, or if the person 'in orbit' tried to run faster.	Learners should plan what they will measure (the speed of the orbit) as they change the pull in the rope. They should consider how to measure the force of the pull (one hand, two hands, leaning back?) Where does the orbiting person feel the pull?	Learners should change places so that they can all feel the effects of the rope pulling on them.

Considerations for inclusion

SFI Curious Minds/ESERO Framework for Inquiry

Investigate: Your Weight on the Moon

Starter Question	Predicting	Conducting the Investigation	Sharing: Interpreting the data / results
How would weighing less affect how you move or jump on the Moon? (Learners might use the ideas from ESERO 48 "How far can you jump?")	I think the astronauts on the Moon will....because.....	Watch the videos https://youtu.be/ZI_VdN6rfrQ and https://youtu.be/g5aPoRtF2vw How would you describe the motion? Compare to how people walk / jump on the Earth. Learners might try to jump and measure the height or length that they can jump. Compare to the height/length that the astronaut can jump on the Moon.	Compare jump height/length differences between individuals in the class and the astronaut. (Mathematics connection: estimate the height of the astronaut jump from the video. He jumps as high as his knee – what distance is that on an adult man?)

Investigate: Day and Night

Starter Question	Predicting	Conducting the Investigation	Sharing: Interpreting the data / results
Where (and why?) is it night-time when it is daytime in Ireland?	Younger children tend to have an egocentric view of the world and are likely to explain that it is night-time because we need to sleep, rather than linking night-time to the concept of a spherical world that turns.	Create models and use them to explain why day and night occur. 2-D models can be made from paper (See ESERO 30 "Day and Night in the World" . 3-D models can be made from spheres and torches.	Review terms such as the poles, axis, rotation (turning). Learners should explain that the Sun appears to move, but that is because the Earth is turning. Ask learners to demonstrate with physical models.

Take The Next Step

Applying Learning	Making Connections	Thoughtful Actions

Model orbits with a soft item at the end of a piece of string. How does the item move if the string is suddenly let go? To keep an object in orbit there must be a force pulling the object towards the middle of the circle, otherwise the object will fly off.
Further explore the observable effects of the seasons with **The Sun and Shadows Toolkit** (http://www.spaceweek.ie/wp-content/uploads/2020/05/Sun-and-Shadows-Toolkit.pdf)

Reflection	Did I meet my learning objectives? Are the learners moving on with their science skills? Ask the learners if they enjoyed the lesson. What questions worked very well? What questions didn't work well? Ask the learners would they change anything or do anything differently. Are there cross curriculum opportunities here?

What does gravity do?
Gravity

08

time
60 minutes.

learning outcomes
To:
- learn what an attractive force is
- discover that on Earth we can only float with help
- know what gravity is

materials needed
- 24 cut-out sheets for lesson 4
- 12 containers
- 12 Lego bricks
- 12 clothes pegs
- 12 wooden beads
- 12 table tennis balls
- 12 pencil sharpeners
- 12 hair elastics
- 12 ordinary elastic bands
- 12 hair pins with a metal (iron) joining clip
- 12 sandwich bags with a twist tie
- 12 corks
- 12 magnets
- scissors
- a paperclip
- sticky tape

Tip. This lesson uses the same materials as in Lesson 4. You can combine these lessons if you like.

Preparation
For the activity **All kinds of forces** you will need a magnet and paperclip.

For the activity **How does it fall?** you will need to prepare 12 containers. Into each container place the following items: one Lego brick, clothes peg, wooden bead, table tennis ball, pencil sharpener, hair elastic, ordinary elastic band, hair pin, sandwich bag twist tie, and piece of cork.
Make 24 copies of the cut-out sheet for Lesson 4.

All kinds of forces 10 min.
Explain to the children that there are different kinds of forces. Show them how the magnet attracts the paperclip. This is called *attractive (magnetic) force*. Encourage all the children to stand next to their chair and pull on the chair. The chair moves. Explain that this is because the children are exerting force on the chair. This force comes from their muscles, so it is called *muscular force*. Now ask all the children to jump in the air. They all land back on the ground. Explain that this is because the Earth is pulling them with an invisible force. We call this force *gravity*. Gravity holds all the people and animals in the world on the ground, so that we don't float around in the air.

The children investigate what gravity does.

Good to know.
Birds may appear to float in the sky but they have to work very hard to stay up there. If they don't then the force of gravity soon brings them back down to the ground.

How does it fall? 25 min.

Organise the children into pairs. Give each pair a cut-out sheet for Lesson 4. The children work together to cut out the pictures on the sheet. Explain that they are going to use these pictures to investigate what happens when you drop something. For this they will need the container with 12 objects. Can they see that the objects in the container match the pictures that they have just cut out?

Ask one child from each pair to stand on a chair and drop the objects in turn. The other child sits on the ground and watches each object carefully as it falls. Keep showing what the other child is dropping. Ask the class the following questions: In what direction do the objects fall? What happens if you throw them up in the air first?

At the end they stick all the pictures from the cut-out sheet in the position where the objects landed. In this way the children learn that all objects fall, but how and where they fall is different.

Did it fall? 10 min.

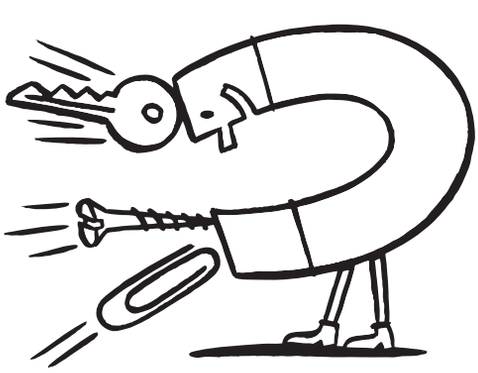
Sit in a circle with the children. Ask the children what happened during the experiment. Ask the following questions:

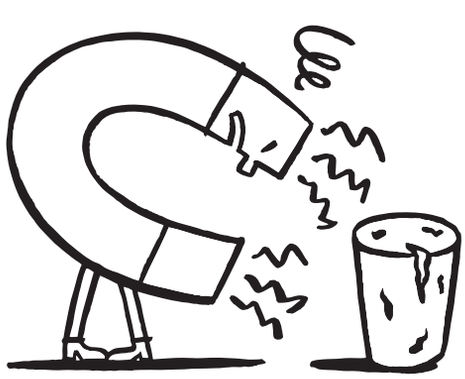
- Did any of the objects go up in the air?
- Did any of the objects stay up in the air? Or did they all fall to the ground?
- Why do the children think all the objects fall to the ground?

Explain that on Earth, everything you throw up in the air will come back down again. This is because of the Earth's gravity.

What do magnets do? 15 min.

Explain that you are going to investigate what magnets do. Give each pair of children a magnet, a container of objects, and one of the remaining Lesson 4 worksheets.
After testing each object the children will sort them into two groups: those which are attracted by the magnet and those which are not.
The children then cut out the pictures and place them in the category to which they belong. Discuss the results together.





Feel gravity
Gravity

28

time
45 minutes.

learning outcomes
To:
- know that gravity is a force
- learn that gravity pulls everything towards the centre of the Earth.
- learn that you can feel the force of gravity yourself

materials needed
- plastic cup
- embroidery needle
- water
- bucket

Preparation

For the activity **Falling water** you will need a plastic cup, an embroidery needle and a bucket.

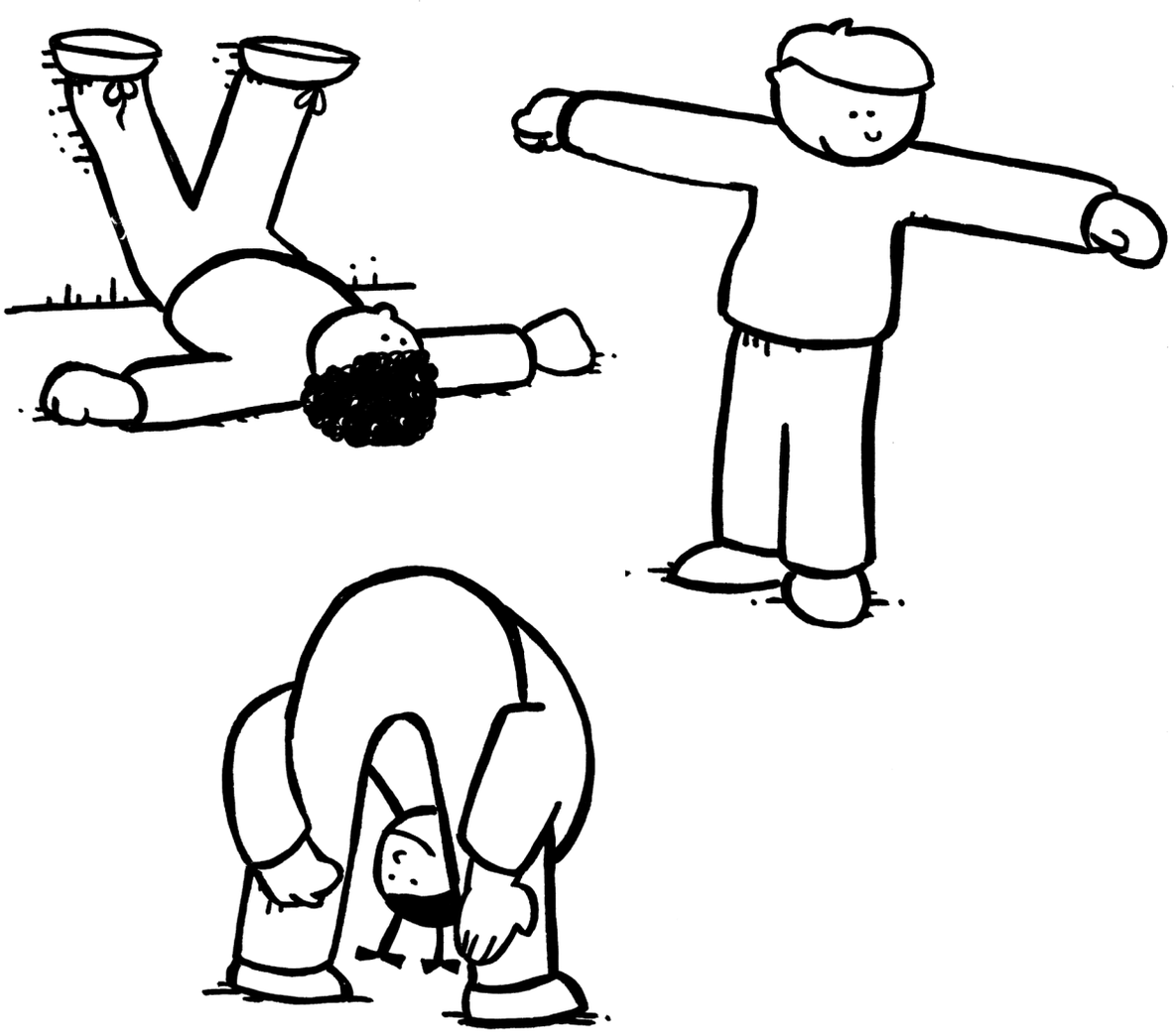
Falling water 10 min.

Sit in a semicircle with the children. Take the plastic cup.
Let it fall. Ask the children what happened. Why did the cup fall? Explain that this is caused by gravity. Gravity is an invisible force that pulls people, animals, plants and objects towards the centre of the Earth.
Use the embroidery needle to make a hole in the bottom of the plastic cup. Make sure the children can see what you are doing. Ask what will happen if you fill the cup with water. Hold the cup over the bucket and fill it with water. What happens? The water runs out through the hole.
Cover the hole with your finger. Now the water stays in the cup. Ask the children if the water will still run out if you drop the cup. Allow some time for discussion. Then drop the cup. The children will see that the water stays in the cup. Why does the water stay in the cup? Explain that this is because the water is falling at the same speed as the cup.

The children investigate what gravity is.

Hanging head 10 min.

Now encourage the children to feel gravity for themselves. They are going to stand and bend over with their head between their knees and look at the child behind them. Then ask them to stand upright and stretch out their arms as shown in the picture.



What does it feel like to bend over like this? Where can they feel the blood flowing? Do they find it difficult to stand with their arms stretched? What force makes this difficult?

Explain that when they bend over, more blood flows to their head. This is because of gravity 'pulling' the blood downwards. The same force makes it difficult to hold your arms outstretched.

You need strength to hold your arms up, but eventually gravity pulls them back down again.

On its head? 15 min.

Give each child a pencil and together look at the picture of the Earth for Task 1 of the worksheet. Read through the instructions together. First of all the children turn over the page and draw what they have read about. Once they have drawn the boy with the cloud and the rain, they turn the paper 180 degrees. When they have finished drawing the girl with a cloud and rain, encourage them to examine their drawing closely. What do they notice? What happens to the rain? In what direction do the raindrops fall? Do the raindrops fall towards the Earth or away from it? Reach the conclusion that in one of the drawings the raindrops fall 'down', and in the other drawing they appear to fall 'upwards', but in both drawings they actually fall towards the Earth. Ask the children why this is. Explain clearly that gravity is always pulling everything towards the middle of the planet. That is why you can never fall off the planet, even if you are standing on the opposite side!

What do you know about gravity? 10 min.

Ask the children what they have learned in the previous activities.
What did they find out from the falling cup of water? What did they feel when they were bent over? And when they had their arms outstretched? What did we find out from the drawing on the worksheet? Explain that gravity is always present, but that you don't always notice it. The children complete Task 2 on the worksheet. Reach the conclusion that the Earth's gravity pulls everything towards the centre of the planet.

Feel gravity

1 On its head?

Read the instructions

Finish the drawing on the back of the worksheet.

1 Draw a boy standing on the planet.

2 Draw him holding an umbrella.

3 Draw a cloud above the umbrella.

4 Draw rain falling out of the cloud.

5 Turn the paper.

6 Draw a girl standing on the planet.

7 Draw her holding an umbrella.

8 Draw a cloud above the umbrella.

9 Draw rain falling out of the cloud.

2 What do you know about gravity?

Put a tick against what you know. There is more than one right answer.

Because of gravity:

- ○ rain always falls towards the Earth.
- ○ your hair hangs down.
- ○ you can hold your arms outstretched.
- ○ we stay standing on the ground.

How far can you jump?
Gravity

48

time
65 minutes.

learning outcomes
To:
- know what gravity is
- discover that a small jump on Earth is a much bigger jump on the Moon
- discover that a small jump on Earth is a much smaller jump on the Sun
- know that different celestial bodies have different levels of gravity
- know that the stronger the gravity of a celestial body, the smaller their jump will be

materials needed
- colouring pencils
- long rope
- measuring tape at least 3 metres long
- gym mats

Preparation

Part of this lesson should take place in the gym. (The children will be doing the long jump.) Make sure the gym is available.
For the activity **Jumping on the Moon and the Sun** you will need two long ropes.
For the activity **How far can you jump?** you will need the measuring tape and the gym mats.

Falling apple 15 min.

Tell the following story.

It's a lovely summer's day when Isaac wakes up. He's on holiday. Isaac hasn't made any plans for the day. First of all he eats his breakfast, then he decides to go for a bike ride. He cycles through the woods and fields. After a while he comes to a park. His legs are tired from cycling so he stops for a rest under an old apple tree. Isaac is lying in the grass enjoying a nap when all of a sudden an apple falls out of the tree and hits him on the head! He wakes up, and begins to wonder why the apple fell down. Why doesn't an apple fall up?

Ask the children why they think an apple doesn't fall upwards.
Explain that this is because of gravity. The force of gravity pulls people, animals, and objects towards the Earth. Encourage the children to feel this for themselves by jumping in the air. After they jump up they always land back on the ground.
After this look together at the illustration at Task 1 on the worksheet.
Encourage the children to circle the activities that have to do with gravity.
Discuss their answers.

The children investigate how far they would be able to jump on celestial bodies that have a different gravity.

Jumping on the Moon and the Sun 10 min.

Take the children to the gym. Line up the children next to each other along the wall of the gym. Lay a rope on the ground one metre from where they are standing. Encourage them to jump over the rope. They have now jumped one metre. Ask if it was a difficult jump. Explain that if they were to use the same amount of energy to jump on the Moon, they would go much further. Ask the children to return to their position at the wall. Now lay the rope on the ground six metres from where the children are standing. Can they jump over the rope now? They can't do it here on Earth, but on the Moon they could. If the children wanted to do the same jump on the Sun, they would only be able to jump 3 centimetres.

Differences in gravity 10 min.

Sit in a circle with the children. Discuss Task 1. The children made a one-metre long jump on Earth. If they were to use the same energy to jump on the Moon, they would land six metres away! If they were to use the same energy to jump on the Sun, they would only move three centimetres! Explain that gravity on the Sun is so strong that it would be very difficult to even get off the ground. On the Sun the invisible force of gravity pulls you very strongly towards the centre of the Sun. The gravity on the Moon pulls less strongly than the gravity on Earth. The astronauts who landed on the Moon discovered this for themselves. At every step they took they were launched into the air as if they were on a trampoline. Explain to the children that they would not really be able to walk on the Sun because it is far too hot.

Good to know. The strength of the gravity of a celestial body is determined by its mass, not its size. For example, Saturn is much bigger than Neptune, but Neptune's gravity is much stronger than Saturn's.

How far can you jump? 10 min.

It is not only the Sun and the Moon that have a different gravity from Earth. The other planets also have different gravity.
Position the gym mats so that the children can jump safely. Encourage the children to jump as far as they can. Measure the distance they jumped. Invite each child to make three jumps. The children can use the result of their best jump for Task 2 on the worksheet. Round up the distance they jumped to the next whole metre and write this down.

Return to the classroom. Ask the children to compare the distance they jumped on Earth with the distance they would have travelled if they made the same jump on the other planets. The children complete Task 2 on the worksheet. Read through the task with the children before they begin, and discuss the answers when they have finished.

Good to know. The different gravity on the various planets means that on the other planets the same amount of energy would enable you to jump a different distance. However, one metre on Earth is the same length as one metre on another planet.

The influence of gravity 10 min.

The children have coloured in the measuring tapes for Task 2. Finish the lesson by completing Task 3. Discuss why the children would not be able to jump so far on Jupiter, Saturn, Uranus, and the Sun. This is because the force of gravity on these planets and the Sun is much stronger.

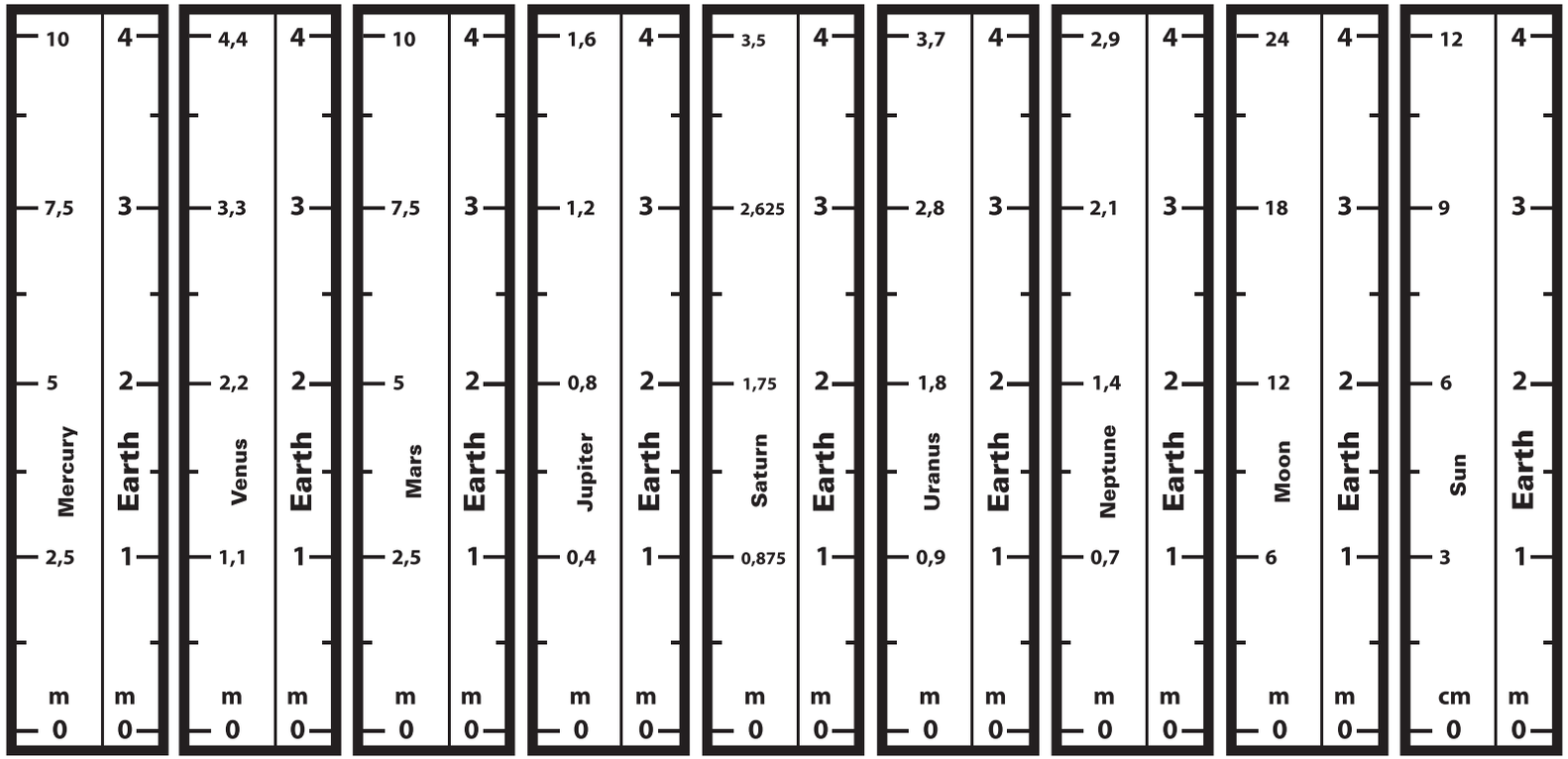
How far can you jump?

1 Falling apple

a Circle the activities that have to do with gravity.

2 How far can you jump?

You have just done your best to jump as far as possible. How far would you have jumped on the other planets? Look closely at the right-hand side of the measuring tapes on the next page. Draw a line at the distance you jumped. On the left side of the measuring tape you can find the distance you would have jumped on the other planet. Mark your distance in each of the measuring tapes and colour them in up to the distance you jumped.



LOOK closely at the right-hand side of the measuring tape.

DRAW a line at the distance you jumped.

On the left side of the measuring tape you can find the distance you would have jumped on the other planet.

MARK your distance in each of the measuring tapes and colour them in up to the distance you jumped.

3 The influence of gravity

a Now you have coloured in all your measuring tapes. What can you see? Can you jump the same distance on all the planets?

b Circle the celestial planets where you can jump further than on Earth.

CIRCLE the correct answer

Mercury / Venus / Mars / Jupiter / Saturn / Uranus / Neptune / the Moon / the Sun

b Circle the celestial planets where you cannot jump as far as on Earth.

CIRCLE the correct answer

Mercury / Venus / Mars / Jupiter / Saturn / Uranus / Neptune / the Moon / the Sun

d The gravity on Jupiter, Saturn, Uranus, Neptune, and the Sun is stronger than the gravity on Earth. Circle the correct answers.

On these celestial bodies I can jump

CIRCLE the correct answer

further / not as far as on Earth.

The gravity on these celestial bodies is

CIRCLE the correct answer

stronger / weaker than on Earth.

The stronger the gravity, the

CIRCLE the correct answer

further / less far you can jump.

How much would you weigh on other celestial bodies?

Gravity

68

time

55 minutes

learning outcomes

To:

- know that we call an amount of mass on Earth weight
- know that the amount an object weighs depends on the gravitational force of the celestial body
- know that mass is a quantity of matter
- know the concept of gravity: an invisible force that pulls everything towards the centre of the celestial body
- know that gravitational force on the Moon is six times weaker than that on Earth

materials needed

- 6 containers
- 6 atlases
- 6 dictionaries
- 6 maths books
- 6 reading books
- 6 full bottles of drink
- 6 ring binders
- weighing scales

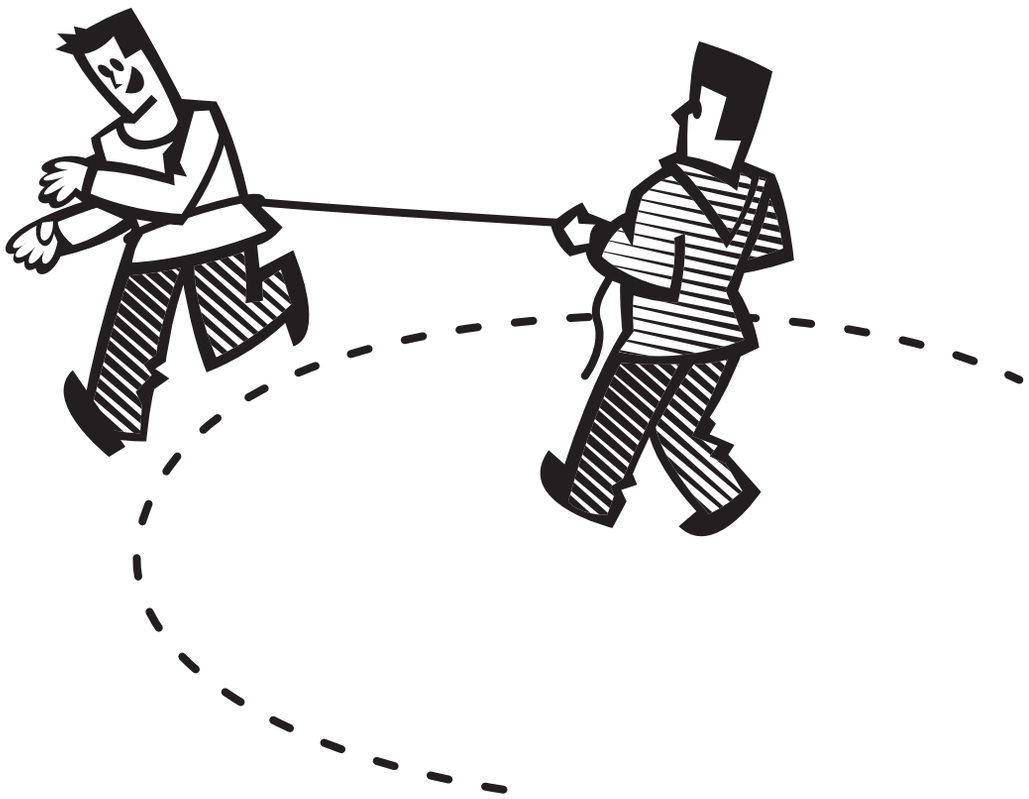
Tip. If possible, carry out the activity **What pulls us?** in the gym.

Preparation

For the activity **Lifting on the Moon** you will need six containers, each of which contains six identical objects. So you will have one container with six atlases, one with six dictionaries, one with six maths books, one with six reading books, one with six full drinks bottles and one with six ring binders.

What pulls us? 10 min.

Organise the children in pairs and give each pair a rope. Child 1 ties the rope around his or her waist as shown in the drawing on the following page.
Child 2 holds the other end of the rope. Child one walks in circles around Child 2. Child 2 must make sure that the rope is kept taut. Ask Child 1 what he or she can feel. The child can feel a force pulling him or her towards the centre of the circle. Gravity is also a force. Explain that gravity is an invisible force that is pulling on everybody. The strength of the gravity that pulls on someone depends upon which celestial body they are on. We cannot see gravity, but it keeps us from floating off into space.



The children investigate the difference in gravitational force experienced on various celestial bodies.

What is weight? 10 min.

Encourage the children to stand on the weighing scales. The children write down their weight in the space provided at the beginning of Task 2 on the worksheet. Ask the children what this number actually means. Explain that when you go to another planet, your weight changes. Why is that? You haven't lost any weight, have you?

Lifting on the Moon 10 min.

Give each pair a filled container. The children complete Task 1 on the worksheet. They are going to feel the difference between lifting something on Earth and lifting something on the Moon.

Discuss the results. Explain that the gravity on the Moon is a lot weaker than the gravity on Earth. This means that on the Moon you are not being 'pulled' as strongly as you are on Earth. So it is easier to lift objects on the moon; they do not feel as heavy as they do on Earth. The children have calculated that the gravity on the Moon is only 1/6 of the gravity on Earth.
So on the Moon their filled container will only weigh 1/6 of its weight on Earth.

Your weight on other planets 10 min.

Now the children calculate how much they would weigh on other celestial bodies. The children fill in the information in Task 2 on the worksheet. When they have finished, discuss the answers.

Weight and gravity 10 min.

The children have calculated that their weight is not the same on every celestial body. They use the list in Task 3 to see the relationship between their weight and gravity. The children come to the conclusion that the stronger the gravitational force, the greater your weight. So, the amount you weigh depends on gravity.

What is your mass? 5 min.

Explain to the children that your weight changes, but your mass remains the same on another planet/celestial body. Your mass is 'how much' you actually weigh. The unit of mass is the kilogram. If we say we weigh fifty kilograms, we mean our weight on Earth. Come to the conclusion with the children that your weight is dependent upon which planet/ celestial body you are on.

How much would you weigh on other celestial bodies?

In this experiment you will be answering the research question:

What is the difference in gravity on various celestial bodies?

1 Lifting on the Moon

What do you need?

- a container from your teacher

What do you need to do?

1 Pick up the full container. Make sure you lift it safely by bending your legs and not your back. The container is heavy!

a Are you able to lift the full container?

_____

b How many items are in the container?

_____

2 Take out five of the items.

c Can you lift it now?

_____

b How many items are still in the container?

_____

e What fraction is this of the whole?

_____ part

On the Moon everything weighs 1/6 of what it weighs on Earth. You have just experienced the difference between the Moon's and the Earth's gravitational force. It is much easier to lift the full container on the Moon than on Earth!

2 Your weight on other celestial bodies

On Earth I weigh: _____ kilograms

Mercury

A (weight on Earth) _____ ÷ 5 = _____

B (answer to a) _____ x 2 = _____

C (answer to b) _____ is my weight in kilograms on Mercury

Venus

A (weight on Earth) _____ ÷ 10 = _____

B (answer to a) _____ x 9 = _____

C (answer to b) _____ is my weight in kilograms on Venus

Mars	A (weight on Earth)	_____	÷ 5 = _____
	B (answer to a)	_____	x 2 = _____
	C (answer to b)	_____	is my weight in kilograms on Mars
Jupiter	A (weight on Earth)	_____	÷ 2 = _____
	B (answer to a)	_____	x 5 = _____
	C (answer to b)	_____	is my weight in kilograms on Jupiter
Saturn	A (weight on Earth)	_____	÷ 7 = _____
	B (answer to a)	_____	x 8 = _____
	C (answer to b)	_____	is my weight in kilograms on Saturn
Uranus	A (weight on Earth)	_____	÷ 11 = _____
	B (answer to a)	_____	x 12 = _____
	C (answer to b)	_____	is my weight in kilograms on Uranus
Neptune	A (weight on Earth)	_____	÷ 5 = _____
	B (answer to a)	_____	x 7 = _____
	C (answer to b)	_____	is my weight in kilograms on Neptune
The Moon	A (weight on Earth)	_____	÷ 6 = _____
	B (answer to a)	_____	is my weight in kilograms on the Moon
The Sun	A (weight on Earth)	_____	÷ 30 = _____
	B (answer to a)	_____	is my weight in kilograms on the Sun

3 Weight and gravity

Read carefully through the information below. Compare it with your answers in Task 2. Then answer the questions at the bottom of the page.

On **Mercury** the gravity is **weaker** than on Earth

Op **Venus** the gravity is **weaker** than on Earth

On **Mars** the gravity is **weaker** than on Earth

On **Jupiter** the gravity is **stronger** than on Earth

On **Saturn** the gravity is **stronger** than on Earth

On **Uranus** the gravity is **stronger** than on Earth

On **Neptune** the gravity is **weaker** than on Earth

On **the Moon** the gravity is **weaker** than on Earth

On **the Sun** the gravity is **stronger** than on Earth

a If the gravity is weaker than on Earth, I weigh
more / less than on Earth.

CIRCLE the correct answer

a If the gravity is stronger than on Earth, I weigh
more / less than on Earth.

CIRCLE the correct answer

c How much you weigh
does / does not depend on the gravity

CIRCLE the correct answer

Light and darkness
Light

09

time
80 minutes.

learning outcomes
To:
- know that we need light to be able to see
- name a number of light sources, some of which are natural light sources and some manufactured
- discover that without light you cannot see colours
- know that it is very difficult to perform certain tasks in the dark

materials needed
- photographs of sources of light (Appendix)
- 2 torches
- materials to make a tent in the classroom
- a cube
- 2 books
- blue colouring pencil
- piece of aluminium foil
- book
- bicycle reflector
- tea towel
- a sheet of white A4 paper
- colouring pencils
- 12 blindfolds
- optional: picture book *Can't you sleep, little bear?*

Tip.
Use an assistant to help you teach this lesson.

Preparation
For the activity **It's dark**, you will need a torch and the photographs of the light sources from the Appendix.
For the activity **The light circuit** set up a light corner, a colouring corner and a tent in the classroom. Ensure that it is dark in the tent and place the cube, the book and the blue colouring pencil inside.
Put the aluminium foil, the book, the bicycle reflector and the torch in the light corner. Make sure there are enough colouring pencils in the colouring corner.
For the activity **Out at night** create an obstacle course in the gym or play area. For example, place something on the ground that the children have to step over, a number of cones they have to walk around, and a hoop they have to crawl through.

It's dark 15 min.
Ask the children if they have ever been somewhere where it was really dark. Ask them: 'What could you see?' and 'What could you see when the light came on? Can you explain why?' Conclude that we need light to be able to see properly.

Tip. To introduce this discussion you can read the book *Can't you sleep, little bear?* by Martin Waddell to the children.

Encourage the children to name things that give off light. Explain that some things are a natural source of light, for example the Sun, fire, a firefly, or a bolt of lightning. Other things that give off light are manufactured. Examples include: the lights in the classroom, a bicycle light, a candle and a torch. Display the photographs of light sources in the classroom, and for each one point out whether it is a natural or a man-made source of light.

The children investigate what objects look like when there is no light and look at objects that give off light.

The light circuit 45 min.

Organise the children into groups of three. One group goes to the tent and one to the light corner. The other groups go to the colouring corner. As soon as the groups in the tent and the light corner have finished, another group can take their place. Ask the children not to say what they discovered or did in the tent and the light corner. This will allow each group to find things out for itself. The children who have already been colouring can take their picture into the tent. It doesn't matter if they have finished or not. They will find out that they cannot, or can barely, see their picture in the dark..

With your assistant, sit near the tent and the light corner. The light circuit works as follows:

The tent

Tell the group of three that they are going to go in the tent. Inside the tent are three objects.

Explain that the children have to do their best to find and identify each object. After allowing sufficient time for the task, call the children out and ask the following questions: What was the object made from? What shape was it? What colour was it? Was there a picture on it?

Explain to the children that they can now go into the tent again, but this time with a torch. Ask them if they think they will find out more about the objects this time. Do they think they will find out what colour the objects are? Determine clearly what the children think will be different now they can take a light into the tent. Give the children the torch and send them back into the tent.

When they come out, ask whether anything they saw was different from the first time? Were their predictions correct? What have they learned?

The light corner

This corner contains the following objects: a piece of aluminium foil, a book, a bicycle reflector, and a torch.

Ask the children which objects they think give off, or could give off, light. Examine the objects together and discuss their answers. To see if the objects give off light or not, they can look at them under the tea towel.

The colouring corner

The children who are not in the tent or the light corner can colour the picture on the worksheet. Encourage them to colour yellow everything on the worksheet that gives off light. They can colour the rest in in any colour they choose. When they have finished colouring the worksheet, they can draw other objects that give off light on a white sheet of A4 paper.

Sit in a circle with the children. Ask a number of children what they discovered in the tent. Why is light important? What happens if you don't have any light? Come to the conclusion that without light you cannot see colours or drawings. It is also much harder to find out what an object is made from. Without light you can feel shapes well, though.

Ask a number of children what they learned in the light corner. Do all the objects that the children thought would give off light actually do so? What is a reflector useful for?

Ask a number of children, to show their coloured-in worksheet. What objects did they colour yellow? Why? The following items on the worksheet give light: the floor light, the ceiling light, the fire, the candles, and the lightening bolt. The Moon reflects light, and the Sun gives light as well, but here it is part of the painting.

Ask a number of children to show what they drew on the blank A4 paper. Is this an object that gives light?

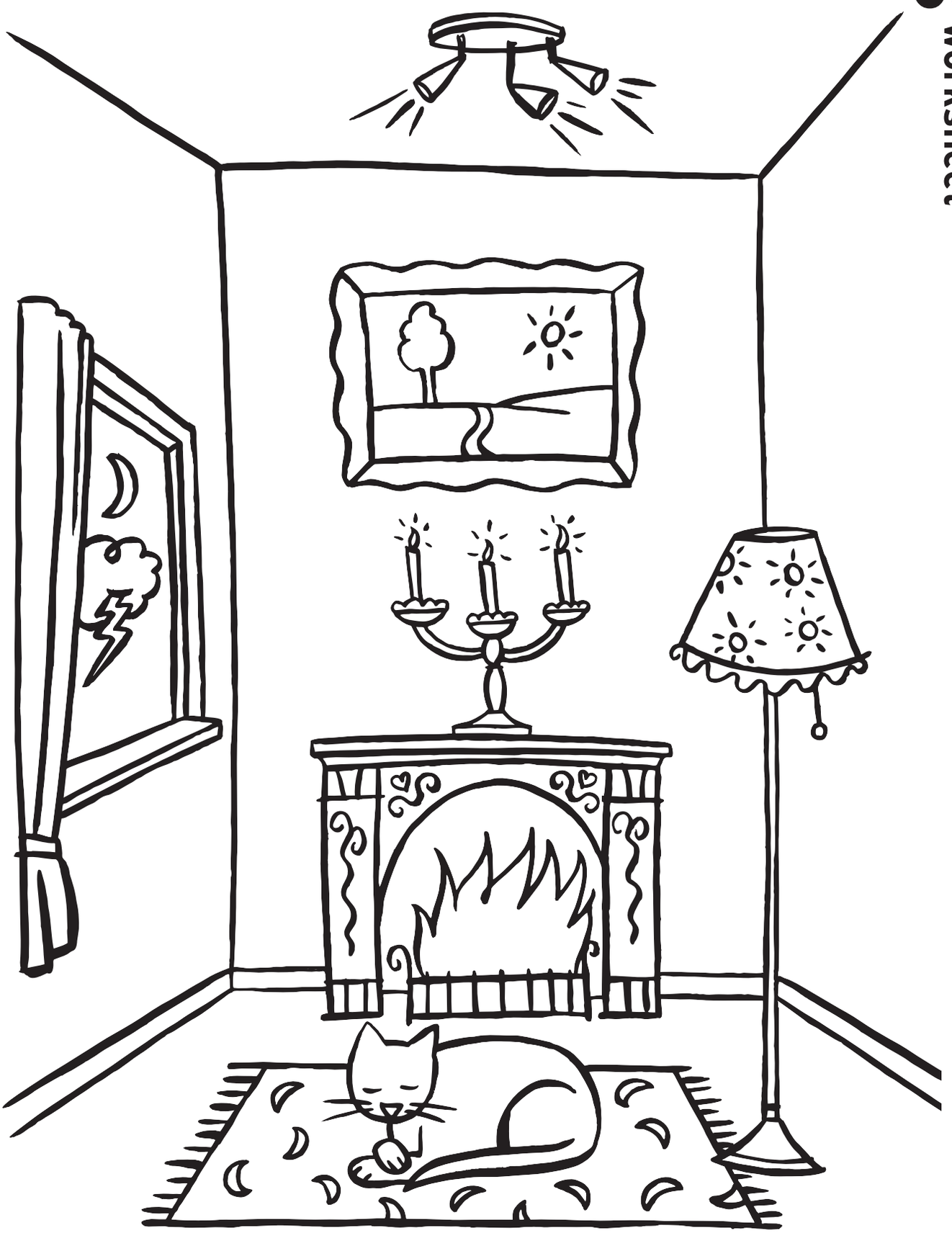
Out at night 20 min.

Discuss why it is that we sleep at night and do things during the day. Explain that long ago people used candles to be able to see when it got dark. They didn't have electric lights like we do now. How dark is it at night if there aren't any lights? Ask all the children to close their eyes. What can they see?

Ask if it would be possible for us to go to school at night and sleep during the day. Why do the children think this would be possible or impossible?

The children are going to role play living in times gone by when there weren't any lights. Take the children to the gym/play area. Divide the children into pairs, giving a blindfold to one from each pair. The other child has to lead the blindfolded child through the obstacle course. When they have completed the course, the children change places.

When everyone has finished, gather the children together. What do they think about what they have just done? Is it easy to do things if you can't see anything? Come to the conclusion that it is very difficult to do things in the dark. During the day we get plenty of light from the Sun, so it is much more convenient to do things during the day and use the night for sleeping.



Sources of light [Sun, lightning, camp fire, electric light] • **LESSON 9**

Day and night in the world
Time

30

time
50 minutes

learning outcomes
To:
- know the difference between diurnal and nocturnal animals
- know that when it is day here, it is night on the other side of the world
- know that it is light when the Sun comes up
- know that it is dark when the Sun goes down

end product
- cut-out worlds showing day and night

materials needed
- photographs of diurnal animals (Appendix)
- photographs of nocturnal animals (Appendix)
- 24 split pins
- 2 cocktail sticks
- torch
- orange
- scissors
- A4 paper
- colouring pencils
- embroidery needles

Preparation

For the activity **Animals in the night** you will need the photographs of diurnal and nocturnal animals from the Appendix. For the activity **Children in the world** cut 24 squares of paper, the same size as the square on the cut-out sheet.

Animals in the night 10 min.

Sit in a circle with the children. Place the photographs of the diurnal and nocturnal animals in the middle of the circle. Ask if animals sleep at night, just like people. Which animals don't sleep at night? When are they awake? Remove the photographs of the diurnal animals. Look at the photographs of the nocturnal animals and talk about how you can recognise a nocturnal animal. Come to the conclusion that nocturnal animals often have bigger eyes than diurnal animals so that they can see better at night. Sometimes they have adapted in other ways as well.

Nocturnal animals can be recognised by specific features, because they live in the dark. The nocturnal animals in the photographs are the bat, the owl, the hedgehog, and the panther.

The children investigate the difference between day and night in the world.

Good to know. **Bats** have such poor eyesight that they do not find their prey by looking with their eyes but by emitting ultrasonic sounds. This sound is reflected from the prey back to their ears. This tells them the distance to their prey. **Owls** have strikingly large eyes. This means they can see their prey clearly at night. **A panther** has eyes with a reflective layer. This enables them to make optimal use of the little light during the night.

Children in the world 15 min.

Give each child a paper square, a pair of scissors and colouring pencils. The children complete Task 1 on the worksheet. Read the instructions together and look at the example. Explain that they need to fold the paper into a triangle. They fold this triangle in half, and in half again. At the top of the folded paper they draw a child as shown in the example on the worksheet. Then they cut this out. Make sure the children only cut the outside of the paper (that they do not cut the centre point). The circle in the middle of the paper should remain intact. When the paper is unfolded, the children will see a planet with a group of children holding hands all around it. Explain that this represents all the children on Earth. Get everyone to colour in two opposite children in two different colours. Explain that one child lives in Europe and the other in Australia. Australia is all the way around the other side of the world.

Day and night in the world 15 min.

Give each child an embroidery needle and a split pin. The children complete Task 2 on the worksheet. Ask them not to cut out the small black circle in the middle. The children place the square over the world with the children from task 1. They use the embroidery needle to prick a hole in the black circle and a hole in the centre of the world from task 1. They place the square over the world and fasten the two together with a split pin.
Demonstrate how it works. The children see that half of the world is covered by the semicircle.

The children turn the uppermost circle round and see that when it is day for the child in Europe it is night in Australia and vice-versa. Ask where it is light when it is dark in Europe. Turn the uppermost circle a little at a time. Can the children see that it is night at a different place on the planet each time? If it is day for the child in Europe, what is it for the child in Australia? Use this to make it clear to the children that when it is day for us, it is night on the other side of the world.

Good to know. Light always travels in a straight line. It is unable to travel around an object; the children saw this in lesson 29. The Earth turns on its own axis once in every 24 hours, and during this time the Sun only shines on the half of the Earth that is facing the Sun. On the other side of the planet it is then night. So we have day and night because the Earth turns on its own axis.

Day and night in the world 10 min.

Take an orange. Explain to the children that you are going to stick a cocktail stick in it to show Europe and one to show Australia. Who knows where the sticks should go? Stick a piece of tape on the stick for Europe so you can tell them apart. Take a torch and say this represents the Sun. Make it dark in the classroom so the light of the torch shows up clearly. Ask the children from which direction the torch needs to shine if it is night in Australia. And if it is night in Europe? Come to the conclusion that it is night there because the Sun is not shining on that side of the Earth. Emphasise what the children have learnt during this lesson by showing an entire day and night. Start with the Sun coming up. Show that the Sun makes it light in Europe. Show that this also means that it is dark on the other side of the world. It is night there. Turn the orange. Show the children that at a certain moment the sun is no longer shining on Europe. It is now night. The Sun is shining on the other side of the world. Compare this with what the children saw in Task 2.

Day and night in the world

1 Children in the world

What do you need?

- scissors
- paper square
- colouring pencils

What are you going to do?

1 Fold the square into a triangle.

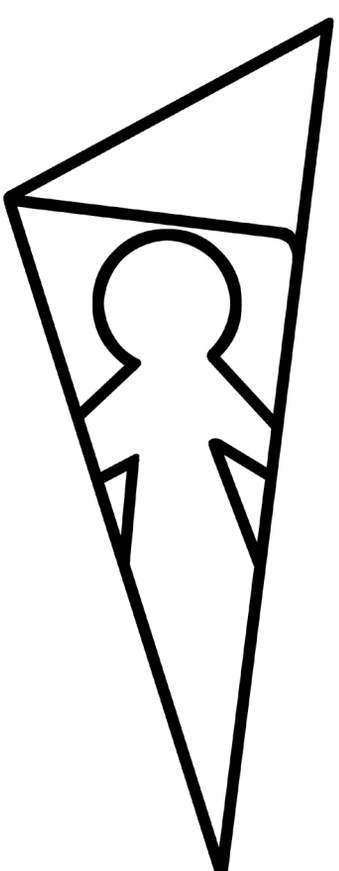
2 Fold this triangle in half and in half again.

3 Draw a child like the one in the example.

4 Cut out the child.

5 Unfold the paper.

6 Colour two opposite children.



2 Day and night in the world

What do you need?

- scissors
- embroidery needle
- split pin

What are you going to do?

1 Cut out the square on the cut-out sheet.

2 Cut out the white semicircle in the square.

Important! Make sure you do not cut out the black circle in the centre.

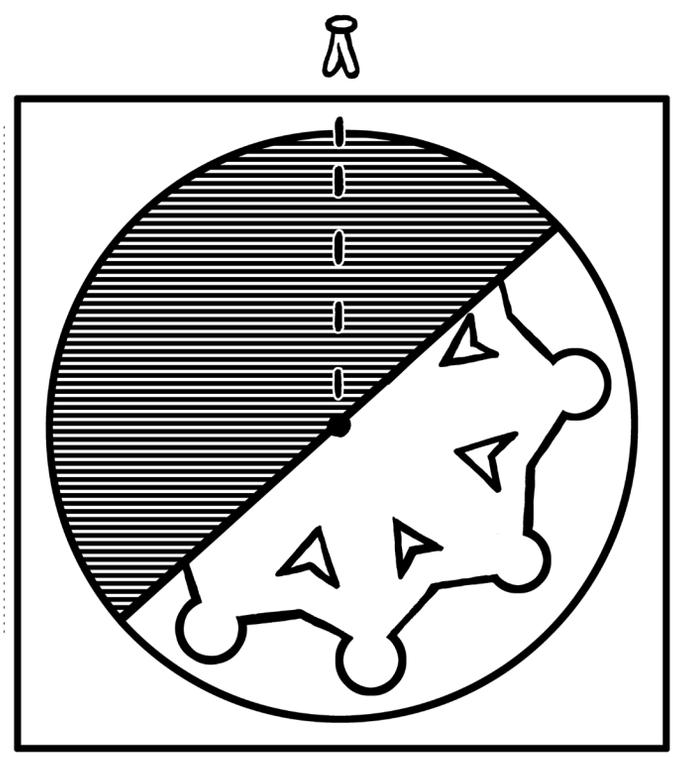
3 Use the embroidery needle to prick a hole in the middle.

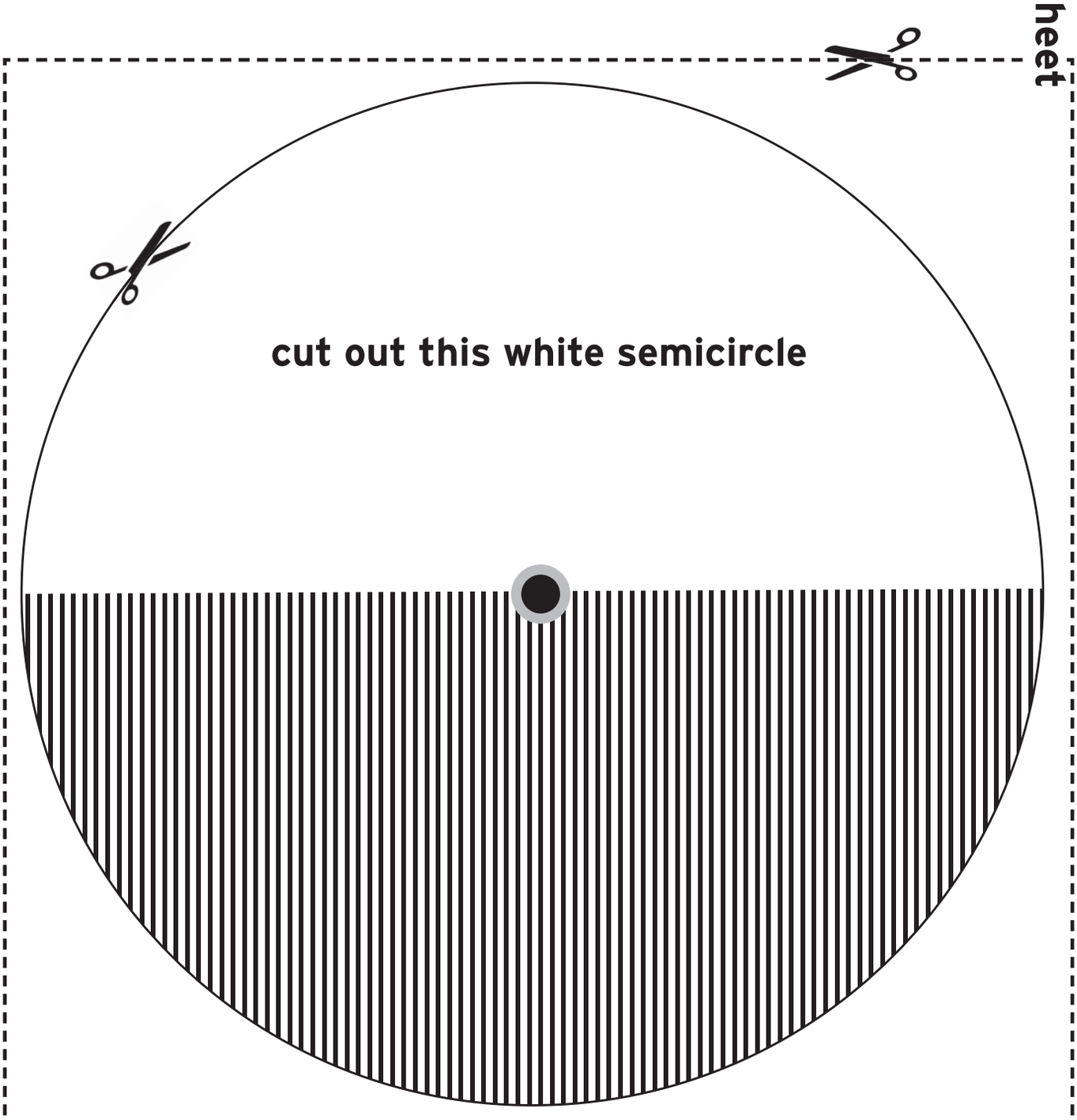
4 Prick a hole in the centre of the world from Task 1.

5 Place the square on top of the world.

6 Push the split pin through the two holes as shown in the drawing below.

7 Open the split pin to fasten it.




cut out this white semicircle

Nocturnal animals [owl, bat, hedgehog, and panther] • **LESSON 30**

Diurnal animals [seagull, hippo, ape, and giraffe] • **LESSON 30**