Curriculum Visions

Earth and space

Teacher's Manual

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Contents

Can't find the activity you're looking for?

Try the detailed topic index on page 80.

Introduction

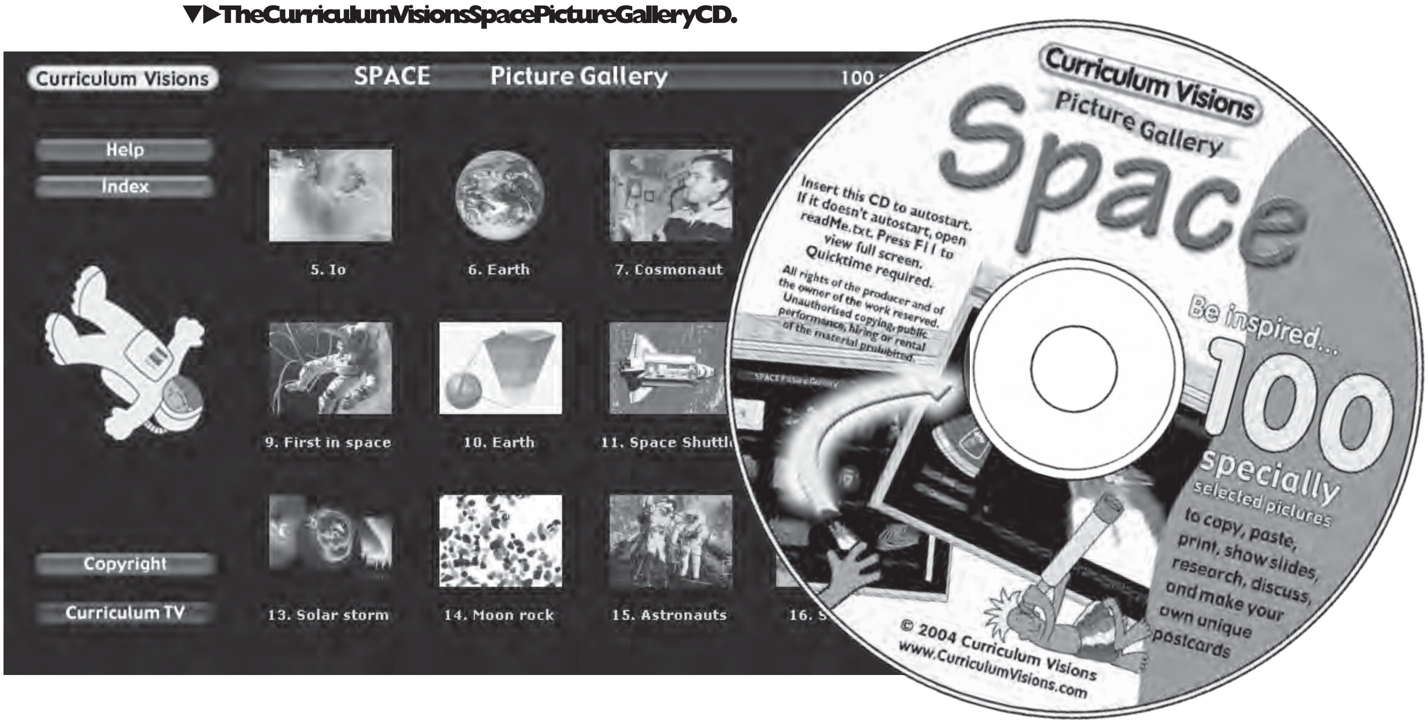
Almost everyone is fascinated with space, and studies on the Earth and space form a part of many science courses worldwide. The aim of this book is to provide an insight into Earth and space studies through 80 activities, which need only everyday materials and equipment. There is also a quizzes section which enables information retrieval skills to be developed.

The activities

- ◆ Each activity has the same format. It begins with a "Why should I do this?" section which in an educational context means the objectives. Here you will find one or more reasons for trying the activity.
- ◆ This is followed with a "What do I need?" section, or resources if you are a teacher. All the resources are easy to gather and a laboratory is not required.
- ◆ Next comes the "Activity" section, which takes you step by step through the experiment.
- ◆ The results of the activity are focused on in the "What have I found out?" section which may also be considered as the outcomes. In this section you may also find extra notes to help with understanding.
- ◆ For teachers, using the activities for a course of work, or parents and carers interested in the educational aspects of the activities, there is a section called "Children trying this activity can". This section looks at the knowledge that the children can gain by doing the activity or the practical skills that are exercised in the investigative work.
- ◆ Finally there is a "Links" section which shows how one activity can be linked to others. By reading through the book and looking at the links you can plan your own course of study. This may range from building up concepts on firm comprehensible lines to taking a trip from Earth through the Solar System and into deep space.
- ◆ Although you can use this book with any others, it does support the *Curriculum Visions* titles *Spaceship Earth*, *Solar System and beyond* and *Journey into space*. More precisely activities 1 to 42 support *Spaceship Earth*, activities 43 to 71 support *Solar System and beyond* and activities 72 to 80 support *Journey into space*. As this last book is in some ways of a more general nature than the first two you will find that many activities earlier in this book also support it through the system of links.

◄This manual may be used with, or independently of, the Curriculum Visions space titles.

▼▶ The Curriculum Visions Space Picture Gallery CD.



- The activities in this book can be used in a variety of ways. Where primary and secondary schools work together to help students make a successful transition between schools, some of the activities can be grouped together to form a bridging unit. For example, some of the activities that support *Spaceship Earth* could be used for project work in the last term at primary school and these could be followed by activities supporting *Solar System and beyond* in secondary school. This would provide progression and allow the children to see how their knowledge and skills learned in primary school can help them in their secondary school work.
- The activities vary in length. The shorter ones could be used as starter activities in both primary and secondary schools to get the lesson off to a flying start or into orbit. The longer activities test a range of skills and can be used as a full scientific investigation.
- Alternatively, as no special materials or equipment are needed, the activities can be performed at home. They can be used to support school work or provide worthwhile experiences for children who find science a fun activity and like to pursue it as a hobby.

The quizzes

At the back of the book (pages 76 to 79) are nine quizzes to test knowledge and develop information retrieval skills using secondary sources. You may use a wide range of resources to find the answers to these questions. Alternatively you may like to use the *Curriculum Visions Space Picture Gallery CD* for which these quizzes were set. If you do use this resource information retrieval skills can be built up in the following way:

1. The answers to the first three quizzes can be found by scanning the gallery and looking at the titles to the pictures. When you click on a picture from the gallery it becomes larger and a caption is revealed where the answer can be found.
2. Quiz 4 provides an introduction to using the index in the gallery. The answers are found by looking at pictures to which there is just one picture reference. When the picture is selected, the answer may be found by clicking on ‘tell me more’, which reveals an information box.
3. In quizzes 5 to 9 the index may be used to search through several picture references to find the answers either in picture captions or information boxes.

1

Spaceship Earth

Why should I do this? (objectives)

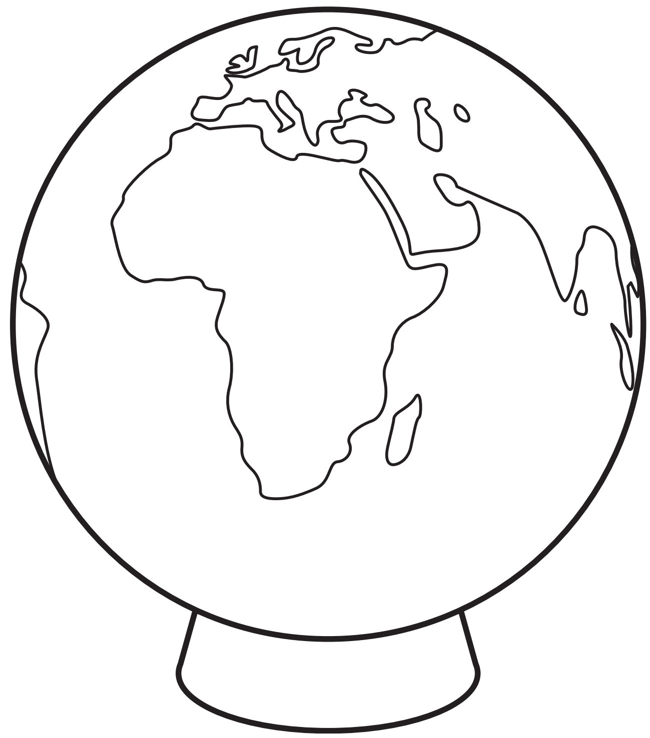
To realise that the Earth is only a very small object in space.

What do I need? (resources)

Table tennis ball, paint brush, blue paint, green paint, a globe, small piece of Plasticine, large open space.

Activity

1. Paint the land and oceans on the table tennis ball using the land and oceans on the globe to help you.
2. Shape the Plasticine into the form of a cup.
3. Rest the table tennis ball, your "Earth", in the Plasticine cup and set it up in the centre of a very large space such as a hall or playground.
4. Walk backwards and notice how the "Earth" becomes smaller and less noticeable.
5. If you have enough space turn round and walk further away then turn back and see if you can find the "Earth".
6. Walk back to the "Earth" – think of it as being a spaceship carrying life forms.
7. Imagine that you are an alien approaching the "Earth" how would you go about making investigations when you reached the planet?



What have I found out? (outcomes)

The Earth is a very small object in space. You do not have to move far from it before it cannot be seen.

Children trying this activity can

- Use simple materials with care.
- Use imagination in answering questions.
- Appreciate the smallness of the Earth in space.

Links Activities 2, 3, 6, 16, 30.

2

Is air a substance?

Why should I do this? (objectives)

To realise that air is a material that covers the planet.

What do I need? (resources)

A small plastic bag (such as one in which a loaf is wrapped).

Activity

1. Open the bag and check that it has not got any holes in it.
2. Squash the bag flat, then open it.
3. Hold out the bag and turn round once, making sure that the bag stays open. It should swell up.
4. Hold the end of the bag firmly closed and try and squash the bag. You should feel that the bag is firm due to the air that you have collected inside. If the air was not a substance, the bag would not behave like this.

What have I found out? (outcomes)

Air is a substance and has a property – it cannot be squashed when sealed in a plastic bag.

Children trying this activity can

- Make observations.
- Draw conclusions.

Links Activities 4, 14.

3

Moisture in the air

Why should I do this? (objectives)

To find out about the different forms of moisture in the air.

What do I need? (resources)

A metal tray, ice cubes, a large transparent jar, some warm water.

Activity

1. Put the ice cubes in the tray and leave for a few minutes until the metal is very cold.
2. Pour warm water into the jar to a depth of about 2.5 centimetres.
3. Put the tray of ice cubes over the mouth of the jar.
4. Watch the inside of the jar. Water will evaporate from the bottom of the jar and form vapour in the air. When the warm vapour meets the cold air at the top of the jar it will condense to form droplets and a cloud will develop.

What have I found out? (outcomes)

Air contains water as a vapour and as water droplets that make clouds.

Children trying this activity can

- Follow simple instructions.
- Make observations.
- Appreciate that there are two forms of water in the air.

Links Activities 5, 7.

4

What makes the sky blue?

Why should I do this? (objectives)

To discover that tiny particles, spread out in a substance, scatter light.

What do I need? (resources)

A transparent bowl, a torch, water, milk.

Activity

1. Pour water into the bowl.
2. Shine the torch through the bowl and look at the path of light. It passes straight through.
3. Add a few drops of milk and stir them into the water so that the water looks very pale. The milk splits up into tiny droplets in the water and they behave as particles of the substances that make up the air.
4. Shine the torch through the side of the bowl and look at the milky water now. You should see that it appears to be slightly blue.

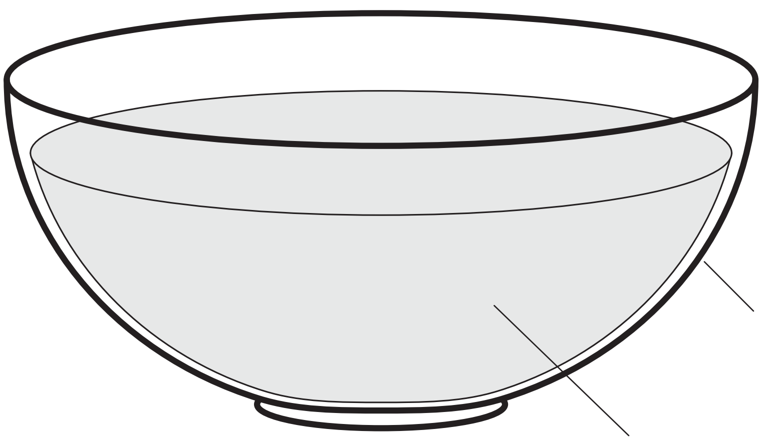
What have I found out? (outcomes)

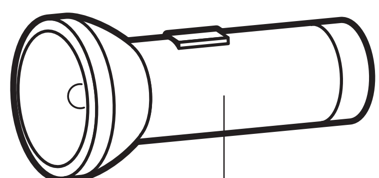
Tiny particles in the air make the sky blue.

Children trying this activity can

- Use simple materials carefully.
- Make observations.

Link Activity 2.





5

Why the oceans are salty

Why should I do this? (objectives)

The oceans cover most of the planet and are composed of salty water. This activity shows how the flow of water over the land contributes to the saltiness of the oceans.

What do I need? (resources)

Sand, salt, a funnel, stand and beaker (or the top cut off a plastic bottle by an adult then inverted into the bottle), cotton wool, beaker of water, magnifying glass.

Activity

1. Put some cotton wool in the bottom of the funnel to act as a plug.
2. Mix some sand and salt together.
3. Pour the mixture into the funnel.
4. Pour water onto the mixture and let it drain through.
5. Collect the water that has passed through the mixture and put some onto a saucer.
6. Put the saucer of water in a warm place such as a sunny windowsill and leave for a few days.
7. Examine the saucer with a magnifying glass and find crystals of salt.

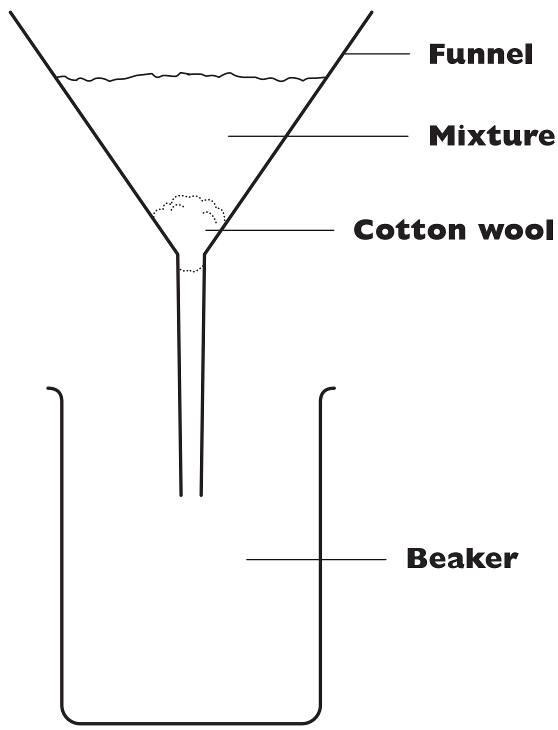
What have I found out? (outcomes)

The water of the oceans contains salt that has been taken from the land.

Children trying this activity can

- Assemble simple apparatus and use it.
- Make observations.
- Discover that salt dissolves in water but sand does not.

Links Activities 6, 7.



6

Moving rock

Why should I do this? (objectives)

To appreciate how rock moves inside the Earth.

What do I need? (resources)

A half full tube of toothpaste with cap.

Activity

1. Make sure that the cap is screwed on tightly.
2. Press on the paste with your fingers and thumbs. Feel it move inside the tube. Rock inside the Earth's mantle moves in a similar way. The paste fills up the empty spaces in the tube like the rock from the mantle fills up spaces in the Earth's crust.
3. Take off the cap.
4. Press the paste slowly towards the nozzle of the tube.
5. When the paste arrives at the mouth of the nozzle slowly press on the tube and let the paste flow down the side of the nozzle. This is similar to the way that lava escapes from a shield volcano.

What have I found out? (outcomes)

Rock inside the Earth moves in a similar way to toothpaste in its tube. When the rock emerges slowly from the Earth it forms a shield volcano.

Children trying this activity can

- Use their sense of touch to feel how rocks inside the Earth move.
- Understand how lava escapes from a shield volcano.

Links Activities 8, 9.

7

Water and life

Why should I do this? (objectives)

To discover that water is needed for living things to grow and breed.

What do I need? (resources)

Some peas, plant pots, dry soil, a cool place, a warm sunny place, dishes of cotton wool.

Activity

1. Soak 20 peas overnight.
2. Put 20 soaked peas on damp cotton wool. Put 20 dried peas on dry cotton wool.
3. Look at the peas every day for signs of germination. When they germinate the pea splits and a root grows out.
4. Plant half the germinated peas in a pot and water the soil. Plant the other half in a pot and leave the soil dry.
5. Water the pot with damp soil regularly.
6. Record how many peas grow a shoot out of the soil.
7. Grow the peas on for many weeks and let them produce flowers and fruits.

What have I found out? (outcomes)

Water is needed for plants to germinate and grow. The presence of water on a planet is essential for the forms of life we know about.

Children trying this activity can

- Carry out a full investigation into germination and growth of peas.
- Record data and present it in a chart or graph.

Links Activities 3, 5, 57.

8

A violent volcano

Why should I do this? (objectives)

To understand that gas pressure can raise liquids inside volcanoes.

What do I need? (resources)

A small plastic bottle, baking soda, vinegar, food colouring, a large dish, sand, a jug, a tablespoon.

Activity

1. Put one tablespoon of baking soda in the bottle.
2. Put the bottle in the centre of the dish.
3. Put sand around the sides of the bottle. Moisten it with a little water to hold it in place.
4. Add a few drops of red food colouring to the jug then pour in the vinegar.
5. Carefully, but quickly pour the vinegar into the bottle.
6. Watch as the gas produced by the substances in the volcano quickly pushes out the liquid (the lava) so that it flows down the side of the volcano.

Note: Gases in the rocks expand as the pressure is reduced near the Earth's surface and this causes them to drive out the lava. In this experiment a chemical reaction is producing the gas.

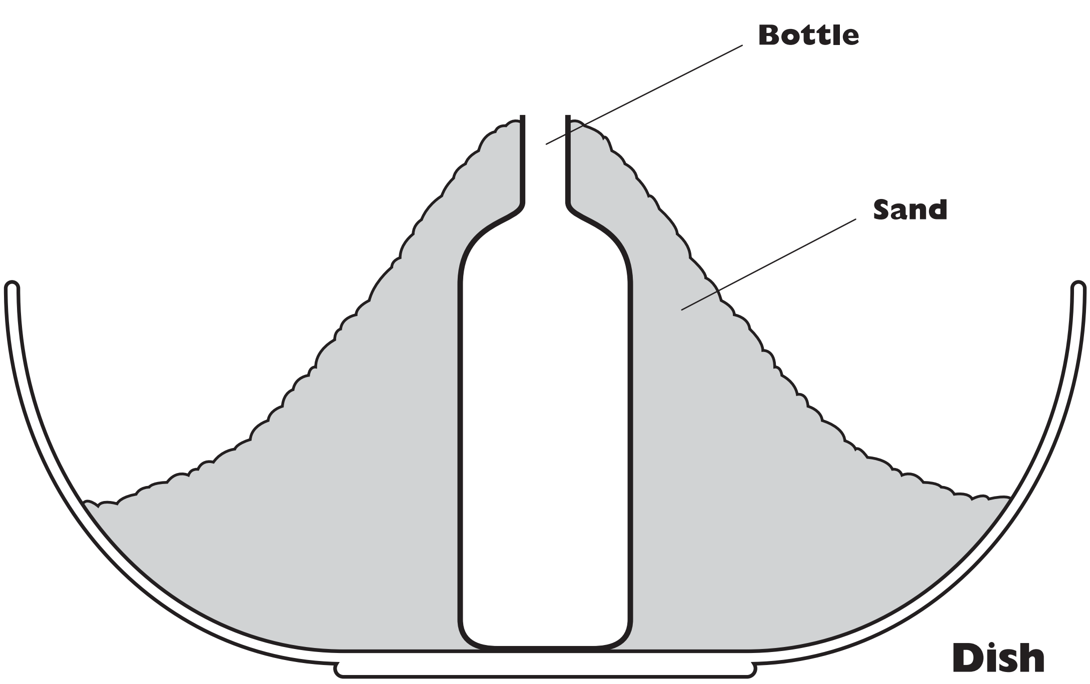
What have I found out? (outcomes)

Gases inside a volcano can cause liquids to escape from inside the volcano and flow away.

Children trying this activity can

- Make a model volcano.
- Understand that expanding gases can cause a volcano to erupt.

Links Activities 6, 9.



9

Is the Earth solid rock?

Why should I do this? (objectives)

To see how the inside of an object affects the way it spins.

To discover a little about the inside of the Earth.

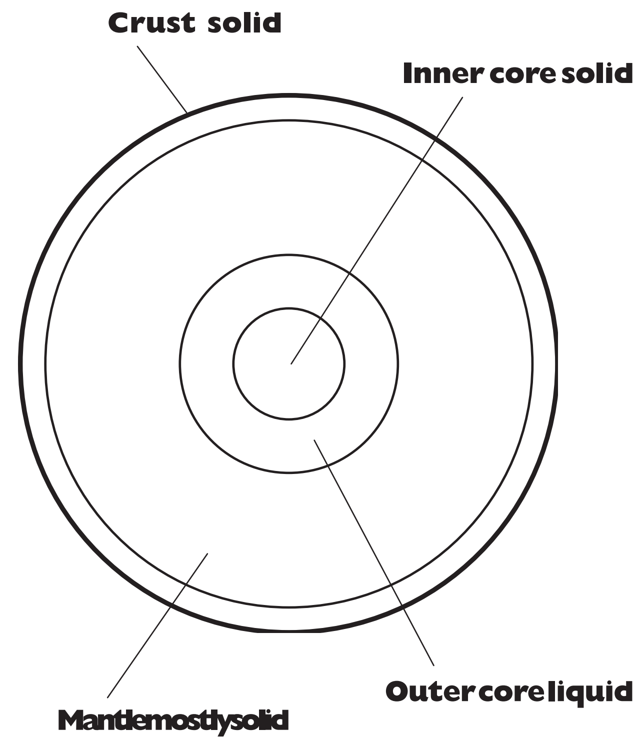
What do I need? (resources)

A hard boiled egg, a raw egg. The egg should be boiled by an adult and allowed to cool before the activity, felt tip pen, stop clock.

Activity

The Earth wobbles as it spins so the purpose of this activity is to see which egg moves more like the Earth.

1. Use the felt tip to mark the boiled egg with a 'B' and the raw egg with an 'R'.
2. Spin the boiled egg and time how long it spins. Notice how much it wobbles. Repeat twice more and calculate an average spin time.
3. Spin the raw egg and time how long it spins. Notice how much it wobbles. Repeat twice more and calculate an average spin time.
4. Compare the spinning time of the two eggs.
5. Compare the way they wobbled. Which egg do you think has an inside similar to that of the Earth?
6. Open each egg. Which one has an inside most like the picture of the inside of the Earth shown opposite?



What have I found out? (outcomes)

The raw egg has solid and liquid parts.
The Earth has solid and liquid parts – it is not solid rock.

Children trying this activity can

- Repeat measurements and calculate an average.
- Compare data.
- Compare observations.

Links Activities 6, 8.

10

Sailing round the Earth

Why should I do this? (objectives)

To appreciate how voyages of discovery helped to show the world was round.

What do I need? (resources)

A large globe, a small piece of Plasticine.

Activity

1. Make the piece of Plasticine into a model ship.
2. Stick your boat on the English channel. You are now going to let it follow the route taken by Francis Drake as he sailed around the world.
3. Move your ship to the coast of Spain then down the coast of Africa and across to the coast of South America.
4. Move your ship down to the coast of South America and around Cape Horn.
5. Move your ship up the coast of South America and North America to just south of San Diego.
6. Sail your ship across the Pacific Ocean to Borneo.
7. Sail your ship through the gap between Sumatra and Java and across to the Cape of Good Hope at the southerly tip of Africa.
8. Move your ship through the South Atlantic Ocean to the coast near Liberia.
9. Sail your ship through the North Atlantic Ocean to the English channel keeping away from the African and European coasts this time.

What have I found out? (outcomes)

Voyages of discovery showed that the Earth was round.

Children trying this activity can

- Identify different parts of the globe.
- See how moving around the globe showed that the Earth was round.

Links Activities 11, 12.

11

Journey on a flat Earth

Why should I do this? (objectives)

To appreciate the consequences of a flat Earth.

What do I need? (resources)

An atlas open at a map of the world, a small piece of Plasticine.

Activity

1. Make the piece of Plasticine into a model ship.
2. Stick your boat on the English channel. You are now going to let it follow the route taken by Francis Drake as he sailed around the world.
3. Move your ship to the coast of Spain then down the coast of Africa and across to the coast of South America.
4. Move your ship down to the coast of South America and around Cape Horn.
5. Move your ship up the coast of South America and North America to just south of San Diego.
6. Sail your ship across the Pacific Ocean past Hawaii and decide what will happen to it next.

What have I found out? (outcomes)

Realise that the idea of a flat Earth has some unlikely consequences such as water around the edges permanently falling into space.

Children trying this activity can

- Identify some parts of a map of the world.
- Use their imaginations to think how a flat Earth could exist.

Links Activities 10, 12.

12

Over the horizon

Why should I do this? (objectives)

To see how objects disappearing over the horizon suggest that the Earth is round.

What do I need? (resources)

A large piece of card on an even larger board, four pins, a model ship.

Activity

1. Pin one edge of the card to the board.
2. Make the card curved so that its centre rises above the pinned edge.
3. Pin the other edge to hold the card in its curved position.
4. Place the model ship on the top of the curve.
5. Look at the boat from one of the pinned edges.
6. Move the ship a little further down the side opposite to you and look at it again.
7. Keep repeating the previous step until you can no longer see the boat. This is how real ships on a real sea move over the horizon. It suggests the Earth is curved.
8. Place the ship on the floor and get down and look at it.
9. Move the ship further and further away so that finally you look at it up to eight metres away. This is how the ship would move away from you if the Earth was flat.

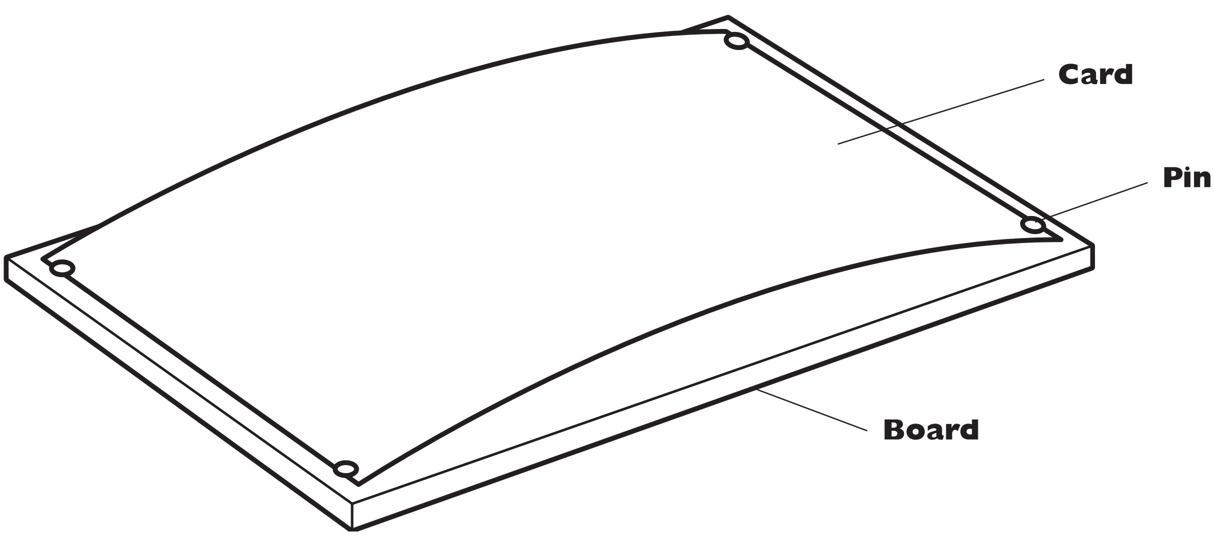
What have I found out? (outcomes)

Ships disappear over the horizon in the following way. First the hull disappears. Then the superstructure built above the hull disappears. Finally the tops of the masts disappear. This suggests the Earth is curved. If the Earth was flat all of the ship would just get smaller and smaller as it went away.

Children trying this activity can

- See how a curved surface makes ships disappear in a different way to a flat surface.

Links **Activities 10, 11.**



13

What do satellites see?

Why should I do this? (objectives)

To see how satellites gather information about the Earth.

What do I need? (resources)

A globe and someone to hold it.

Activity

1. Place the globe on a small table.
2. Pretend that you are a satellite in a low Earth orbit – one just near the end of the atmosphere and at the beginning of space. Look directly at the globe and note what you see – a land mass or an ocean.
3. Move a quarter of the way round the globe and repeat the previous step.
4. Move another quarter of the way around the globe and look directly at its surface and note what you see.
5. Move a quarter of the way round the globe and repeat the previous step.
6. Ask someone to hold up the globe while you pretend to be a satellite in a polar orbit. Look directly at the globe from the side and note what you see.
7. Move up until you are over the North Pole and note what you see.
8. Move half way down the other side of the planet and note what you see.
9. Move under the globe until you are under the South Pole and note what you see.

What have I found out? (outcomes)

As a satellite moves around the Earth it can record different features of the planet.

Children trying this activity can

- Use their imagination to think what it might be like on a satellite looking down on the Earth.
- Distinguish between a low Earth orbit and a polar orbit.

Links Activities 14, 15.

14

Monitoring pollution

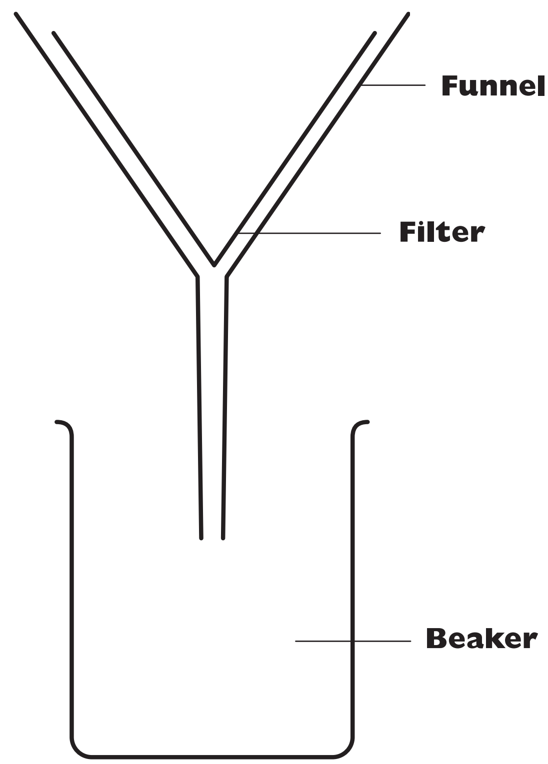
Why should I do this? (objectives)

To be aware of how a form of pollution can be detected.

To be mindful that pollution can damage the planet and threaten the survival of life.

What do I need? (resources)

A filter bag for a coffee machine, a funnel, stand and beaker (or the top cut off a plastic bottle by an adult then inverted into the bottle), magnifying glass, a safe place outside to leave the apparatus for a few days.



Activity

1. Examine the filter bag with a magnifying glass and record what you see.
2. Place the filter bag in the funnel and leave it outside for a few days or until there has been some rain.
3. Remove the filter bag from the funnel and examine it with the magnifying glass.
4. Look for dark marks caused by soot. This is air pollution.
5. Set up the filter bag at different times of year and see if the amount of pollution changes.

What have I found out? (outcomes)

Soot pollution can be monitored by filtering rain water.

Children trying this activity can

- Set up some simple equipment.
- Make observations with a magnifying glass.
- Make comparisons.
- Form a conclusion.

Links Activities 15, 54.

15

Improving a habitat

Why should I do this? (objectives)

To see how the activities of humans can raise the number of different kinds of living things in a habitat.

What do I need? (resources)

A piece of ground such as a piece of wasteland in the school grounds, stones, logs, old bowl, buddleia bush, pond weed from an aquarist shop, spade, plastic cups, trowel, small piece of wood to cover cups.

Activity

1. Dig six holes in the piece of ground and place a plastic cup in each. Fill soil in round the cup and make a cover supported by stones as the picture below shows. These are pitfall traps.
2. Leave the pitfall traps overnight and then look in them in the morning, record what you see and let the animals go.
3. Take up the pitfall traps and fill in the holes.
4. Dig a hole and place the old bowl in it. Add water and pond weed to the bowl to make a small pond. Put stones and logs around the land and plant a buddleia bush.
5. After a month set the pitfall traps again and record what you find.

What have I found out? (outcomes)

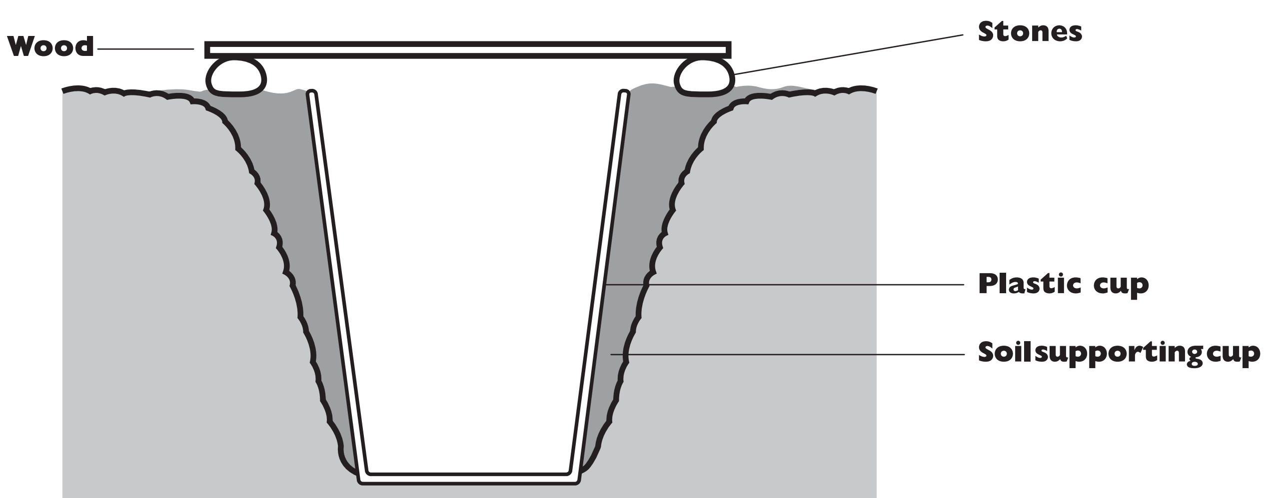
Pitfall traps are a harmless way to record animal life provided they are emptied after a short time.

A habitat can be improved by adding a few simple features.

Children trying this activity can

- Improve a habitat by performing a few simple tasks.
- Record animals in a habitat by using pitfall traps.

Links **Activities 13, 14.**



16

The Earth and the Sun

Why should I do this? (objectives)

To appreciate the relative sizes of the Earth and the Sun and to consider the distance between them in space.

What do I need? (resources)

A ball 14 centimetres in diameter, a peppercorn, a metre rule, a large space such as a hall or a playground, stop clock or watch.

Activity

1. Put the ball in the centre of the large space.
2. Measure 14.96 metres from the ball in any direction and put down the peppercorn.
3. The ball represents the Sun and the peppercorn represents the Earth. The distance between them represents the distance between them in space. Move away from the peppercorn Earth. How far do you have to move before you cannot see it? Can you still see the Sun?
4. Look at the ball then go away from the model and come back in eight minutes. This is the time that it takes for light to travel from the Sun to the Earth. Can you find the Earth easily?
5. On the same scale as this model the Moon would be a speck of dust close to the peppercorn. Look at the peppercorn and imagine this.

What have I found out? (outcomes)

The Sun is much larger than the Earth. The Moon is much smaller still. When approaching the Sun and the Earth through space the Sun is much easier to see than the Earth. Note you must never look directly at the Sun as it can damage your eyes.

Children trying this activity can

- Make a model of the Sun and Earth.
- Appreciate the difference in sizes of the two objects and the distance between them.

Links Activities 1, 17, 31.

17

The tilt of the Earth

Why should I do this? (objectives)

To realise that the Earth does not stand up like a spinning top but that its axis is tilted.

What do I need? (resources)

A piece of Plasticine, a cocktail stick, a protractor.

Activity

1. Pinch a small piece of Plasticine to use as a base to support the cocktail stick and model Earth.
2. Roll the remaining piece of Plasticine into a ball.
3. Push the cocktail stick through the centre of the Plasticine ball. This represents the axis of the Earth.
4. Stick one end of the cocktail stick in the Plasticine base so that the cocktail stick is vertical.
5. Put the protractor next to the Earth and move the upper tip of the cocktail stick until the axis of the Earth makes an angle of 23 degrees with its previous vertical position.
6. You may have to add more Plasticine to the base or reshape the base to hold your model Earth at this new position.

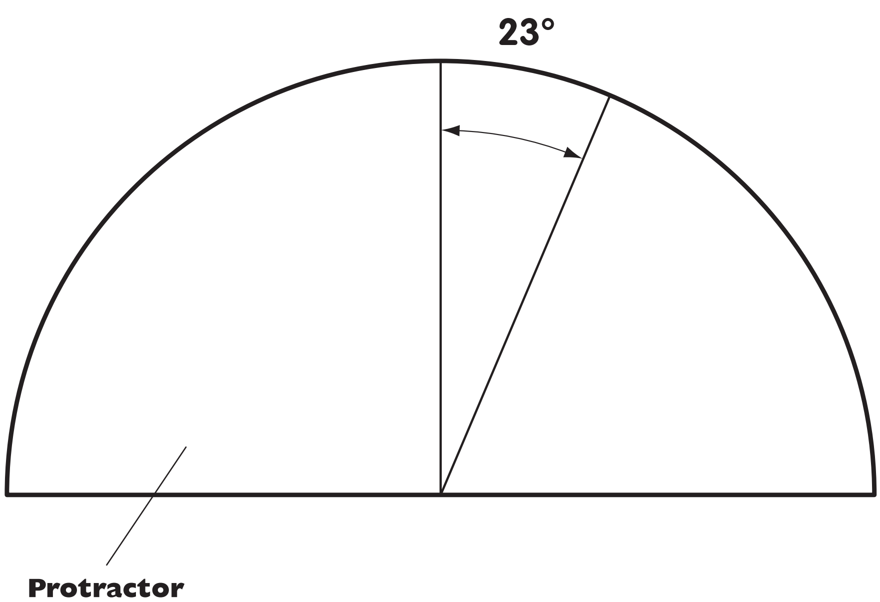
What have I found out? (outcomes)

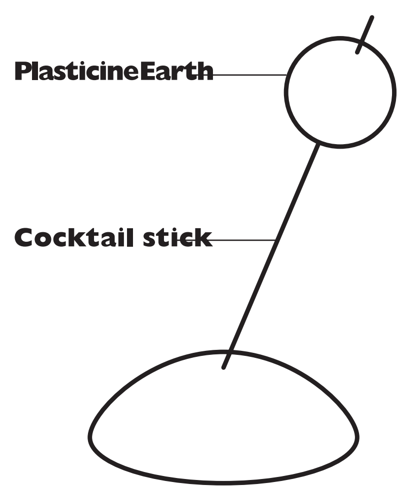
The axis of the Earth is tilted 23 degrees from the vertical position.

Children trying this activity can

- Use materials safely.
- Measure an angle.

Links **Activities 18, 24.**





18

Night and day

Why should I do this? (objectives)

To see which parts of the Earth are lit in daytime and which parts are in the dark at night-time.

What do I need? (resources)

A globe mounted on its base at the correct angle of tilt, a torch (a model Sun), a room that can be darkened, a friend.

Activity

1. Set up the globe on a table.
2. Arrange the globe so that it is tilting towards your friend who is holding the torch.
3. Darken the room and stand to the side of the Earth so it is tilting towards the torch to your right.
4. Ask your friend to switch on the torch and notice which areas are lit up (daytime) and which areas are in the dark (night-time).
5. Look at the tilt of the axis and compare it with the line of the shadow down the two globes shown below. Which picture matches your observations – A or B?

What have I found out? (outcomes)

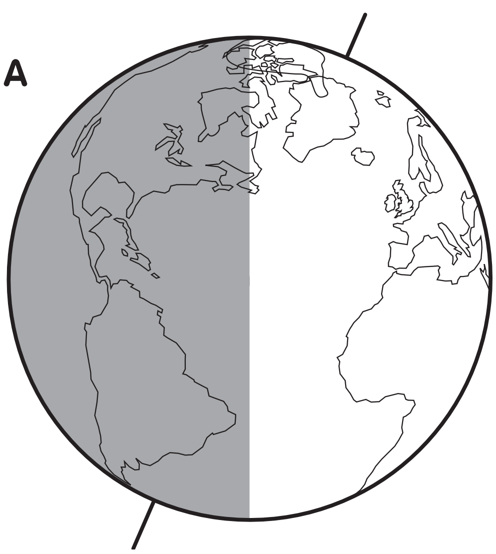
The line of the shadow is vertical down the globe. It does not match the angle of the tilt of the axis. This means that the North Pole can be in light while the South Pole is in darkness.

Children trying this activity can

- Make observations.
- Make comparisons.
- Understand the line of the shadow down the planet does not match the tilt of the Earth's axis.

Links Activities 17, 19, 28.

A



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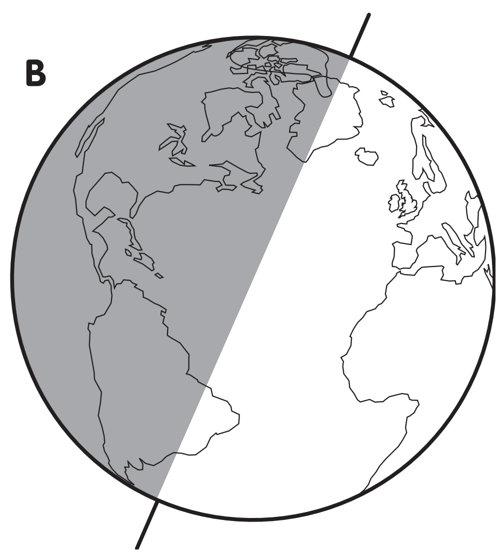


19

The Spinning Earth

Why should I do this? (objectives)

To understand the direction in which the Earth spins and to see how this affects day and night at different places on its surface.

What do I need? (resources)

A globe mounted on its base at the correct angle of tilt, four small pieces of Plasticine, four pieces of a plastic straw, a torch (a model Sun), a room that can be darkened, a friend.

Activity

1. Make four markers by sticking each piece of plastic straw in a piece of Plasticine.
2. Stick a marker on each of the following places – Britain, Japan, the centre of the United States, the centre of Australia.
3. Arrange the globe so that it is tilting towards your friend who is holding the torch.
4. Darken the room and ask your friend to switch on the torch.
5. Turn the globe anticlockwise until the marker for Britain is directly opposite the torch. It is midday in Britain at this time.
6. Notice which other markers are in the light and the dark.
7. Turn the globe anticlockwise and note the order in which the other markers come into the daylight.

What have I found out? (outcomes)

As the Earth spins places move out of the sunlight into darkness and it changes from day to night there. At the same time other places in darkness move into sunlight and it changes from night to day there.

Children trying this activity can

- Carry out instructions to make an investigation.
- See that when the upper part of the planet is tilted towards the Sun that after Britain has been in daylight, places in the United States, Japan and Australia receive daylight in this order.

Links Activities 17, 18, 50.

20

Sunlight and shadows

Why should I do this? (objectives)

To find if the direction of a shadow changes during the day.

What do I need? (resources)

A compass, a stick, an open space, a sunny day, a clock.

Activity

1. Put a compass on the ground and let it settle. It will have part of its needle coloured. This will be pointing north.
2. Beneath the needle is a card with directions on it. Move the body of the compass carefully so that the north direction lies under the coloured part of the needle. From this you can work out all the other directions on the compass.
3. Put one end of the stick in the ground and note the direction of the shadow.
4. Leave the stick and compass and return in an hour and note the direction of the shadow again.
5. Repeat the previous step several times during the day.

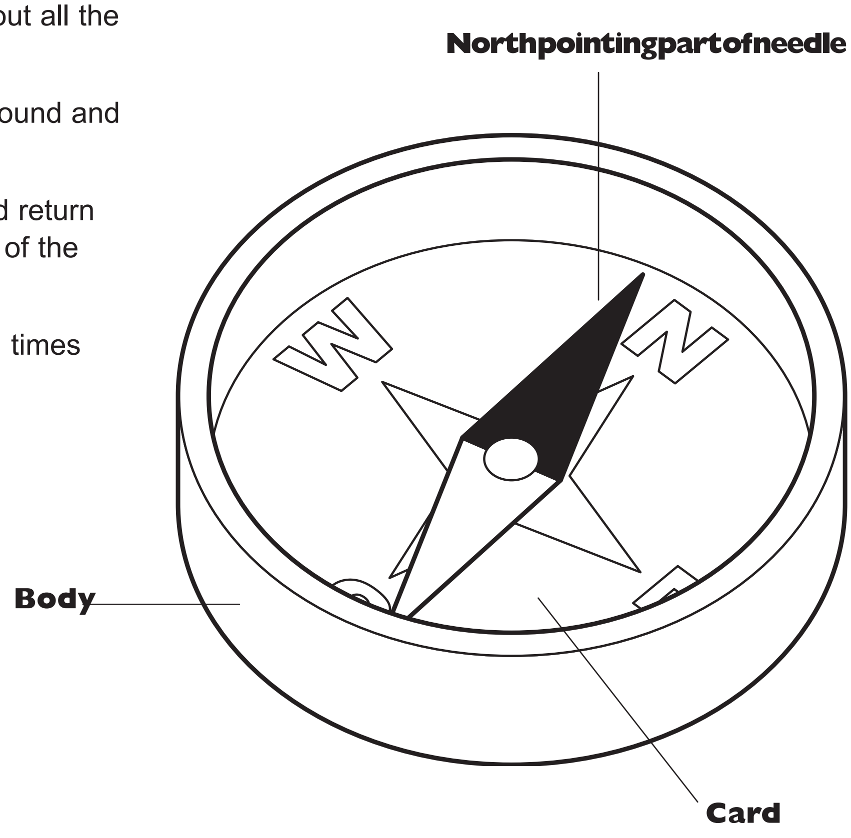
What have I found out? (outcomes)

The direction of a shadow changes during the day. In the Northern Hemisphere, it points to the north west in the morning, at midday it points north and in the afternoon it points north east. In the Southern Hemisphere the shadow points south west, south and south east respectively.

Children trying this activity can

- Use a compass to find directions.
- Discover that a shadow changes direction during the day.

Link Activity 19.



21

Shadow length in sunlight

Why should I do this? (objectives)

To find if the length of shadows changes during the day.

What do I need? (resources)

A ruler, a stick, an open space, a sunny day, a clock.

Activity

1. Put one end of a stick in the ground and measure the length of the shadow.
2. Return to the stick an hour later and measure the length of the shadow again.
3. Repeat the previous step several times during the day.

What have I found out? (outcomes)

The length of a shadow changes during the day. It is at its longest at sunrise and sunset and at its shortest at midday.

Children trying this activity can

- Measure accurately.
- Collect data.
- Interpret data.

Links **Activities 20, 22.**

22

Shadow length and direction

Why should I do this? (objectives)

To investigate two features at the same time. To produce a generalisation about how light and shadows are related.

What do I need? (resources)

A white sheet of paper, an object such as a piece of dowel about four centimetres long, a ruler, a torch, a pencil, a friend.

Activity

1. Place the object in the centre of the paper.
2. Shine the torch from one direction on to the object. Draw an arrow on the sheet showing the direction of the light shining from the torch.
3. Draw an arrow by the object showing the direction of the shadow.
4. Repeat the two previous steps several times from different directions.
5. Ask a friend to hold the torch at a certain height above the paper and shine it on the object.
6. Measure the height of the torch and the length of the shadow produced.
7. Repeat the two previous steps several times for different heights of the torch.
8. If you have tried activities 20 and 21 compare your observations made in this activity.

What have I found out? (outcomes)

The shadow of an object always points in the opposite direction to the torch shining on the object. The length of the shadow of an object depends on the height of the torch shining on the object. If the torch is low the shadow is long. If the torch is high the shadow is short.

Children trying this activity can

- Work out relationships from their observations.
- Compare data from two or more investigations.
- Prepare a generalisation from the results of investigations.

Links Activities 20, 21.

23

The path of the Sun in the sky

Why should I do this? (objectives)

To discover how the Sun appears to move across the sky. If you have done activity 22 you can use the data you collected there to make a prediction here and test it.

What do I need? (resources)

A compass, a ruler, a stick, an open space a sunny day, a clock.

Activity

1. Put the compass on the ground and let it settle. It will have part of its needle coloured. This will be pointing north.
2. Beneath the needle is a card with directions on it. Move the body of the compass carefully so that the north direction lies under the coloured part of the needle. From this you can work out all the other directions on the compass.
3. Put one end of the stick in the ground and note the direction of the shadow.
4. Measure the length of the shadow.
5. Make a prediction of how the shadow's direction and length will change during the day.
6. Record the direction of the shadow and its length every hour through the day.
7. Compare your data with your prediction.

What have I found out? (outcomes)

As the shadow moves from pointing west to pointing east the Sun changes position from an eastern part of the sky to a western part of the sky. As the shadow length shortens during the morning to a minimum at midday and then lengthens again in the afternoon this means that the Sun rises in the sky to its highest point at midday then sinks down again.

Children trying this activity can

- Use a range of equipment (compass, ruler and clock).
- Make a prediction and test it.
- Infer from their results how the Sun appears to move across the sky.

Links Activities 20, 21, 22.

24

How the Earth moves round the Sun

Why should I do this? (objectives)

To relate the direction in which the Earth tilts as it moves around the Sun in its orbit to the summer and winter seasons.

What do I need? (resources)

A globe mounted on its base at the correct angle of tilt, a large yellow ball (a model Sun), a small table.

Activity

1. Place the ball on a table.
2. Hold the globe so that its base is horizontal and it tilts at 23 degrees to the vertical.
3. Point the top of the globe in a certain direction and move round the ball on the table keeping the top of the globe pointing in the same direction.
4. Keep moving round and then stop when the top of the Earth tilts towards the Sun. This is the time of summer in the upper part of the globe called the Northern Hemisphere and winter in the lower part of the globe called the Southern Hemisphere.
5. Move round again until the top of the globe tilts away from the Sun. This is the time when it is winter in the Northern Hemisphere and summer in the Southern Hemisphere.

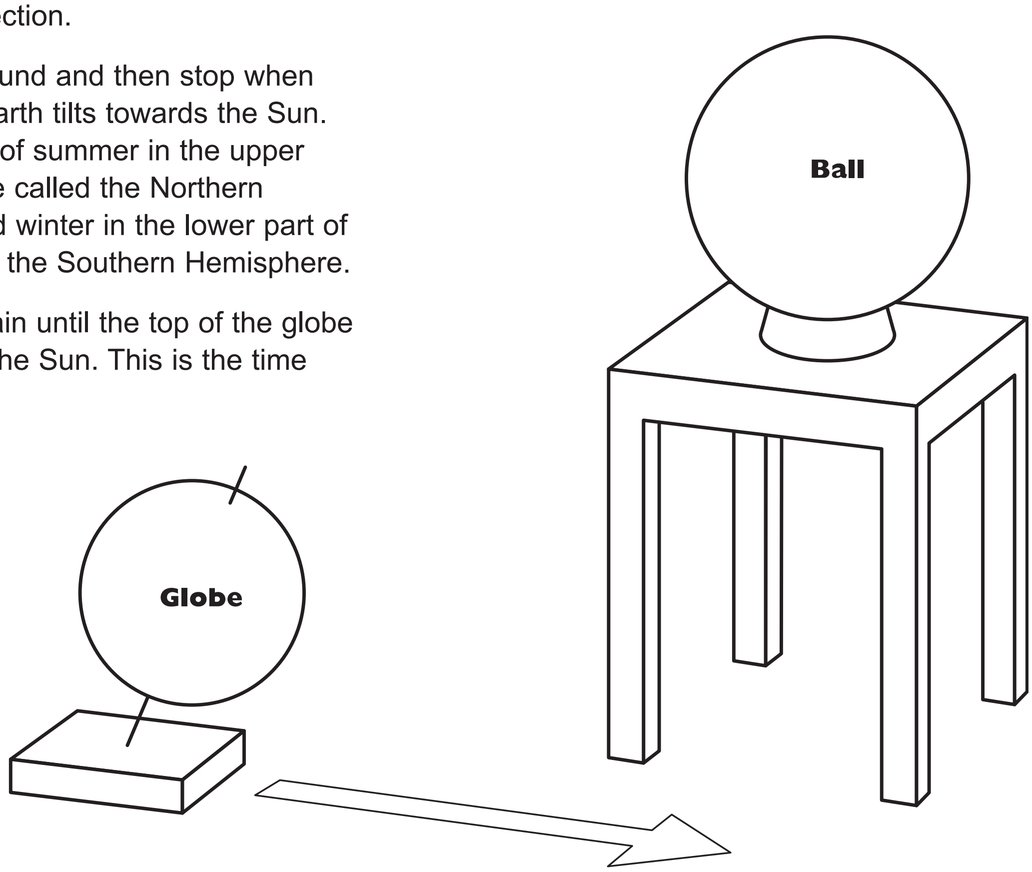
What have I found out? (outcomes)

As the Earth moves around the Sun it keeps tilted in the same direction. Summer and winter are due to the way the Earth tilts as it moves round the Sun.

Children trying this activity can

- Perform a simple role play by following instructions.
- Understand that the seasons are related to the way the Earth is tilted as it moves around the Sun.

Links Activities 18, 25, 72, 75.



25

Tilting in the sunshine

Why should I do this? (objectives)

To discover how the tilt of the Earth affects the sunlight shining on it.

What do I need? (resources)

A torch, card, sticky tape, scissors, a large orange.

Activity

1. Cut a piece of card to fit over the front of the torch.
2. Make a hole in the centre of the card about a centimetre in diameter. The light shining through this hole is a model sunbeam.
3. Stick the card on the front of the torch.
4. Shine the torch at the side of the orange then move the top so that it tilts forwards towards the torch. Look at the size of the area brightly lit up by the torch beam.
5. Move the top of the orange so that it tilts away from the torch. Look at the size of the area lit up by the beam now and compare its brightness with that in the previous step.

What have I found out? (outcomes)

When a curved surface is tipped towards the light, a smaller area is brightly lit as the light is high and shines down on the surface. When a curved surface is tipped away from the light, a wider area is less strongly lit as the light is lower and shines across the surface.

Children trying this activity can

- Compare areas of illumination.
- Work out a relationship between the tilt of the Earth and the way sunlight shines on it.

Links **Activities 24, 26, 52.**

26

When light shines straight down

Why should I do this? (objectives)

To find out how the temperature of an object changes when light shines on it from overhead. To see the importance in repeating experiments.

What do I need? (resources)

Thermometer, black card, desk lamp, half metre rule, clock.

Activity

1. Put a thermometer on a piece of black card and record its temperature.
2. Set up a desk lamp 30 centimetres above the thermometer as the picture below shows.
3. Leave the lamp switched on for five minutes.
4. Record the temperature.
5. Switch off the lamp and let the thermometer and paper cool down to their original temperature.
6. Work out the temperature rise by subtracting the first thermometer reading from the second.
7. Repeat the experiment twice and work out the average rise in temperature.

What have I found out (outcomes)

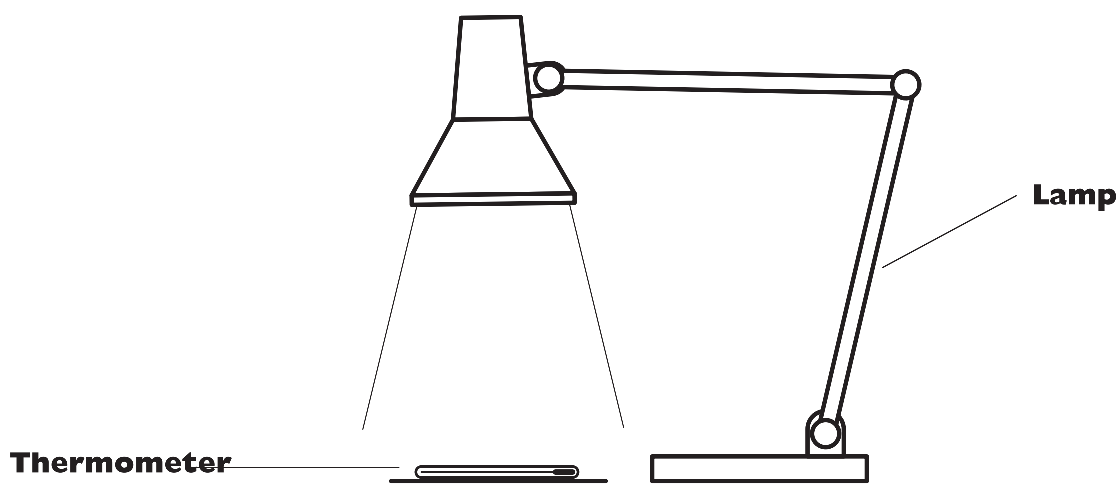
When an experiment is repeated different measurements may be recorded.

Note: The data recorded here is needed for activity 27.

Children trying this activity can

- Use a thermometer.
- Perform a subtraction.
- Work out an average.

Links Activities 24, 25, 27.



27

Warming up in slanting light

Why should I do this? (objectives)

To find out how the temperature of an object changes when slanting light shines on it. To see the importance in repeating experiments. If you have done activities 25 and 26 you should have enough information to make a prediction about the investigation then test it.

What do I need? (resources)

Thermometer, black card, desk lamp, half metre rule, clock.

Activity

1. Put a thermometer on a piece of black card and record its temperature.
2. Set up a desk lamp to one side of the thermometer as the picture shows.
3. Leave the lamp switched on for five minutes.
4. Record the temperature.
5. Switch off the lamp and let the thermometer and paper cool down to their original temperature.
6. Work out the temperature rise by subtracting the first thermometer reading from the second.
7. Repeat the experiment twice and work out the average rise in temperature.
8. Compare the data recorded in this investigation with that recorded in activity 26.

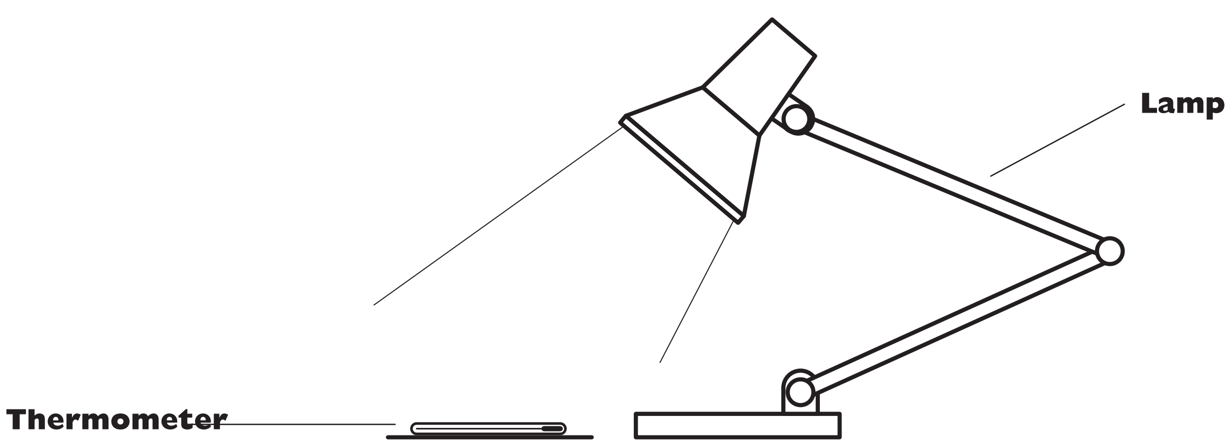
What have I found out (outcomes)

When an experiment is repeated different measurements may be recorded. The thermometer and card heat up less strongly with the slanting light than with the light shining overhead. This explains why summer is hotter than winter because the Sun shines from a higher position in summer than in winter due to the way the Earth tilts in its orbit.

Children trying this activity can

- Make a prediction and test it.
- Compare data.
- Draw conclusions from comparisons.

Links Activities 24, 25, 26.



28

Sunrise and sunset

Why should I do this? (objectives)

To find out where sunrise and sunset take place on the horizon. To see how the positions of sunrise and sunset change over time.

What do I need? (resources)

A compass, a view of a wide horizon such as from a hill top. This is easier to do between late autumn and early spring when sunrise may be around 7:00 a.m. or later.

Activity

1. Put a compass on the ground and let it settle. It will have part of its needle coloured. This will be pointing north.
2. Beneath the needle is a card with directions on it. Move the body of the compass carefully so that the north direction lies under the coloured part of the needle. From this you can work out all the other directions on the compass.
3. Look for the place on the horizon where the sun will rise. It is brighter than other parts of the sky. Do not look at the Sun – its light can damage your eyes.
4. Look for the place on the horizon where the sun has set. It is brighter than other parts of the sky. Do not look at the Sun – its light can damage your eyes.
5. Repeat the previous two steps each week for a few weeks. How do the positions of sunrise and sunset change?

What have I found out (outcomes)

The position of sunrise and sunset changes on the horizon. From later autumn to winter the sun rises and sets more to the south. From winter to spring the sun rises further and further east and sets further and further west. This is related to the way the Earth tilts as explored in activity 24.

Children trying this activity can

- Discover the directions of the horizon.
- Find that the positions of sunrise and sunset change over a few weeks.

Links Activities 18, 29.

29

Day length through the year

Why should I do this? (objectives)

To discover how day length changes through the year. To see how this relates to the way the Earth tilts as it goes round its orbit. To see how a line graph can be used to present more detailed information than a bar chart.

What do I need? (resources)

A desk diary with the times of sunrise and sunset in it. They are found at the front of the diary among the general information.

Activity

1. Look at the time of sunrise and sunset for the first date given in January. Work out the number of hours and minutes between them to find the day length.

2. Repeat the previous step with the first date of each month through the year.

3. Produce a bar chart showing the change in day length through the year.

4. The desk diary will include the times of sunrise and sunset for every week of the year. Work out the hours of day length for each week in any three month period and present the data as a line graph.

What have I found out (outcomes)

In the Northern Hemisphere the day length increases from January to June and then decreases again from June to December.

Children trying this activity can

- Calculate day length from the times of sunrise and sunset.
- Produce a bar chart.
- Draw a line graph.

Links **Activities 25, 28, 30.**

30

The shadow clock

Why should I do this? (objectives)

To see how the shadows from the Sun can be used to tell the time. To assess the use of a shadow clock over a long period.

What do I need? (resources)

Board, paper, sticky paper, Plasticine, pencil, compass, clock.

Activity

1. Make a shadow clock like the one shown in the diagram below.
2. Use a compass to find north and set up the shadow clock in a sunny window or in an open space outside with the side with the pencil to the south (in the Northern Hemisphere) or to the north (in the Southern Hemisphere). Start as early in the day as you can and mark the position of the shadow cast by the pencil every hour.
3. On the next sunny day use your shadow clock to tell the time. Check the time it shows with the clock. How accurate is the clock?
4. Repeat the previous steps in the weeks and months ahead. Does the number of hours the clock can be used change?

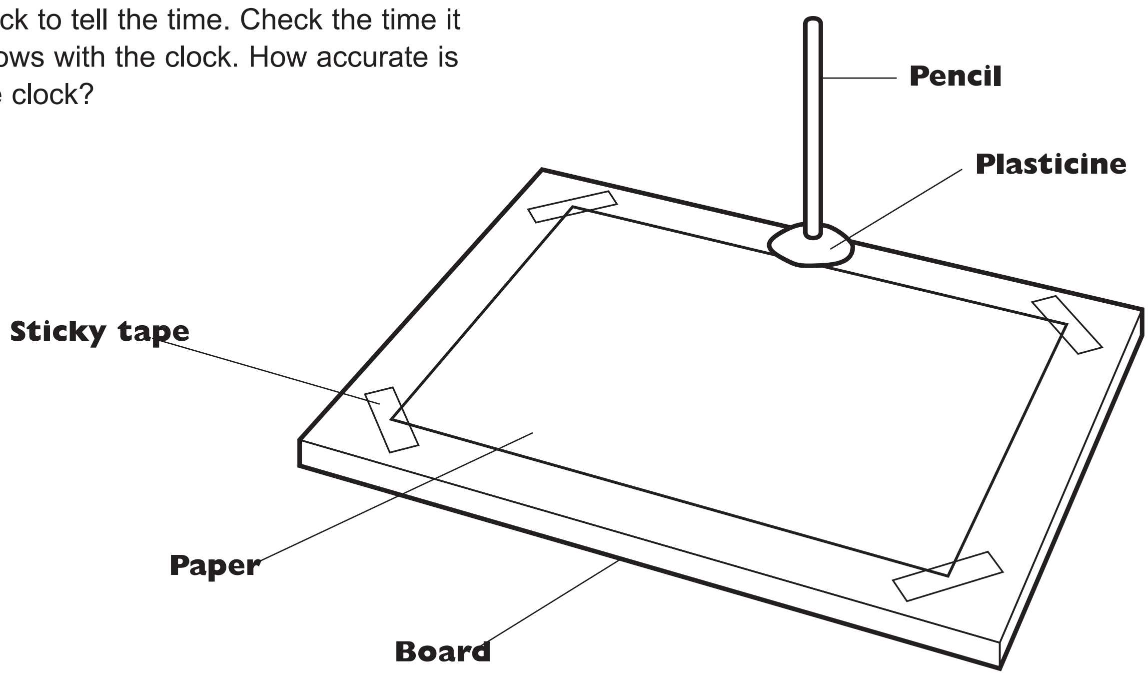
What have I found out (outcomes)

A shadow clock can be used to tell the time. The number of hours the clock can be used does change with the seasons. This is due to the path of the Sun. The sundial can be used earlier in the morning and later in the evening in summer than in winter.

Children trying this activity can

- Make a shadow clock.
- Use a shadow clock to tell the time.
- Assess the usefulness of a shadow clock.

Links Activities 22, 29.



31

The Earth and the Moon

Why should I do this? (objectives)

To compare the sizes of the Earth and the Moon with the distance between them.

What do I need? (resources)

A large piece of Plasticine, a metre rule.

Activity

1. Use some of the Plasticine to make a ball 6 cm in diameter. This is a model of the Earth.
2. Use some of the Plasticine to make a ball 1.5 cm in diameter. This is a model Moon.
3. Set up the Earth on the floor and measure 190 cm in any direction. Place the Moon at this point.
4. Look at the scale model of the Earth and Moon. Imagine Saturn with its rings. It would just about fit between the Earth and the Moon.

What have I found out (outcomes)

That the Moon is smaller than the Earth but both appear small compared to Saturn and its rings.

Children trying this activity can

- Make a model of the Earth and Moon.
- Appreciate the distance that there is between the Earth and the Moon.
- Appreciate how Saturn and its rings compare to the size of the Earth and the Moon.

Links Activities 1, 16, 32, 60.

32

Earth, Moon and Sun

Why should I do this? (objectives)

To appreciate how the Moon moves around the Earth as the Earth moves around the Sun.

What do I need? (resources)

A beach ball, a small table, a football, a tennis ball, a felt tip pen and a friend.

Activity

1. Place the table in the middle of an open space such as the school hall.
2. Put the beach ball on the table. This is the Sun.
3. The tennis ball is the Moon. Make a few black marks on one half of the tennis ball. This is the side of the Moon that always faces the Earth.
4. Stand about five metres from the table and hold the football over your head. This is the Earth.
5. Ask a friend to stand about one metre away from you and hold the tennis ball over their head making sure that the side with the black marks faces the Earth.
6. Ask your friend to slowly walk round you in an anticlockwise direction as seen from above. They should make sure they turn the Moon so the black marks always face the Earth.
7. Begin to walk slowly round the Sun in an anticlockwise direction while your friend continues to walk around you. Can you and your friend make one orbit of the Sun without the Moon and Earth colliding?

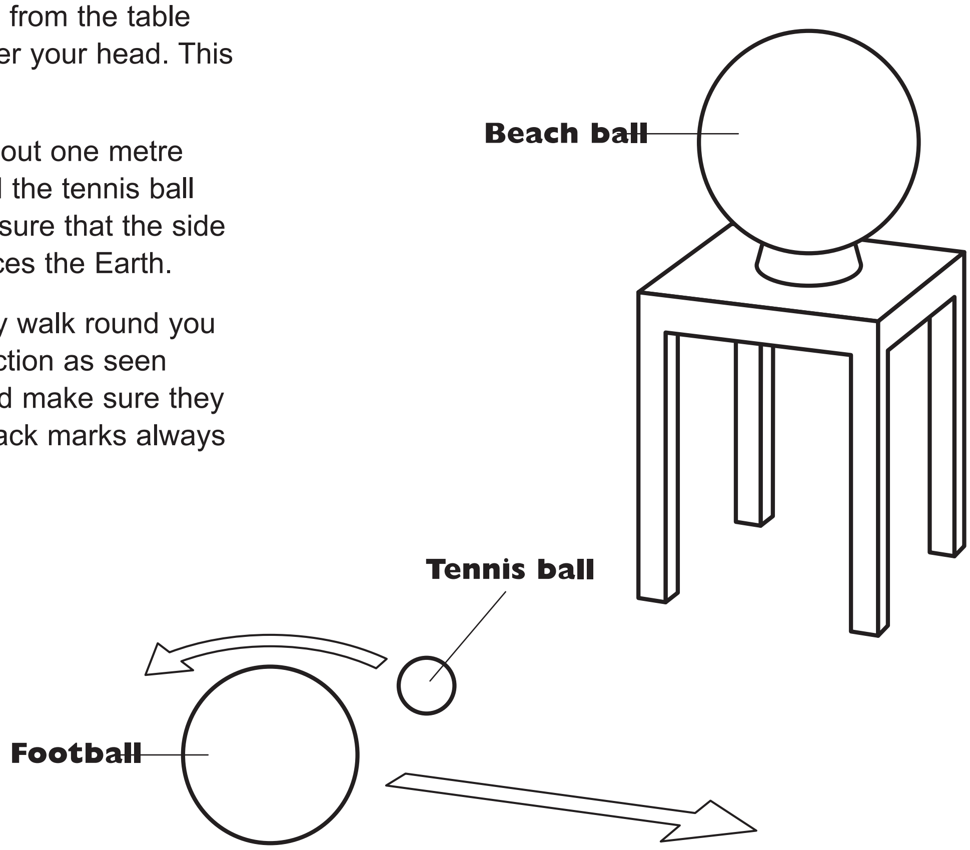
What have I found out (outcomes)

The Moon orbits the Earth while the Earth orbits the Sun.

Children trying this activity can

- Use role play to discover how the Earth and Moon move.
- Use models to represent the Sun, Earth Moon system.
- See that the Moon moves around the Earth while the Earth moves around the Sun.

Links Activities 33, 34, 47, 72, 75.



33

How shapes shine

Why should I do this? (objectives)

To find out how the shape of an object affects the light reflected from its surface.
To understand why objects in space shining with reflected light might not be showing their true shape.

What do I need? (resources)

A box (cube), a tin (cylinder), a ball (a sphere), a torch, a dark room.

Activity

1. Set up the objects and torch on a table then make the room dark.
2. Shine the torch on the cube and note which places reflect light. Could you tell it was a cube just from the reflected light you see?
3. Move the torch and shine on different parts of the cube. See how the shape of the reflected light changes.
4. Repeat the previous two steps with the cylinder.
5. Repeat the previous step with the ball. Note how the ball appears circular when the light shines from you directly onto it. Note how a crescent shape is produced when the light shines from the side.

What have I found out (outcomes)

The shape of an object in darkness cannot always be seen clearly by any light reflecting from it. The area of reflected light from a sphere ranges from crescent to full disc depending on the position of the light beam.

Children trying this activity can

- Make observations and comparisons.
- See the relationship between the position of the light beam shining on a sphere and the shape of the area of reflected light.

Link Activity 34.

34

Modelling the phases of the Moon

Why should I do this? (objectives)

To see how the orderly change of direction of the light shining on a sphere produces an orderly change in the light reflected from the sphere.

What do I need? (resources)

A ball, a torch, a dark room.

Activity

1. Make the room dark and hold the torch in your right hand and the ball in your left.
2. Hold up the ball and torch in front of you. Shine the torch (representing sunlight) from your right and note that the crescent shape (crescent Moon) is made by the light reflected from the ball.
3. Move the torch slowly so that it comes to shine onto the ball from in front of your face. Notice how the area of the ball lit up by the torch changed. The area increased until half the side of the ball facing you was lit (half Moon) then increased again until the whole side was lit up (full Moon).
4. Put the ball in your right hand and the torch in your left hand.
5. Shine the torch onto the ball from in front of your face and slowly move the torch until it shines on the ball from your left side. Notice how the full Moon changes into a half Moon and then into a crescent.

What have I found out (outcomes)

The shape of the area of reflected light from the Moon depends on the position of the light beam shining on the Moon.

Children trying this activity can

- Follow instructions to carry out an experiment.
- Relate the position of a light beam to the area of reflected light on a sphere.
- See how the different shapes of area of reflected light from the Moon (the phases of the Moon) are related to the way sunlight shines on it.

Link Activity 35.

35

A diary of the Moon

Why should I do this? (objectives)

To find out how the amount of sunlight reflected from the Moon changes. To recognise the different phases of the Moon.

What do I need? (resources)

A diary, the night sky.

Activity

1. Begin tonight by looking at the Moon and drawing its shape.
2. Look at the Moon every night for a month if possible and draw its shape or phase.
3. Label the phases using this information to help you. When the crescent is getting larger it is a waxing crescent. After that the Moon surface is half lit and is called first quarter. The area of sunlit Moon increases in the waxing gibbous stage until the full Moon stage is reached. This is followed by the waning gibbous phases, the last quarter and the waning crescent. When the Moon is new its surface facing us is not lit by the Sun but the following night a thin crescent appears which many people call the new Moon.

What have I found out (outcomes)

The phases of the Moon have names and follow an orderly sequence.

Children trying this activity can

- Make observations.
- Identify a pattern.

Links

Activities 33, 34, 36, 41.

36

The phases of the Moon

Why should I do this? (objectives)

To relate the phases of the Moon to the positions of the Sun and the Moon.

What do I need? (resources)

The drawings of the phases of the Moon from activity 35.

Activity

1. Make a copy of this diagram.
2. Note the position of the new Moon and the arrows showing the path of the Moon around the Earth and shade in the circles to show the phases of the Moon from new Moon to new Moon.

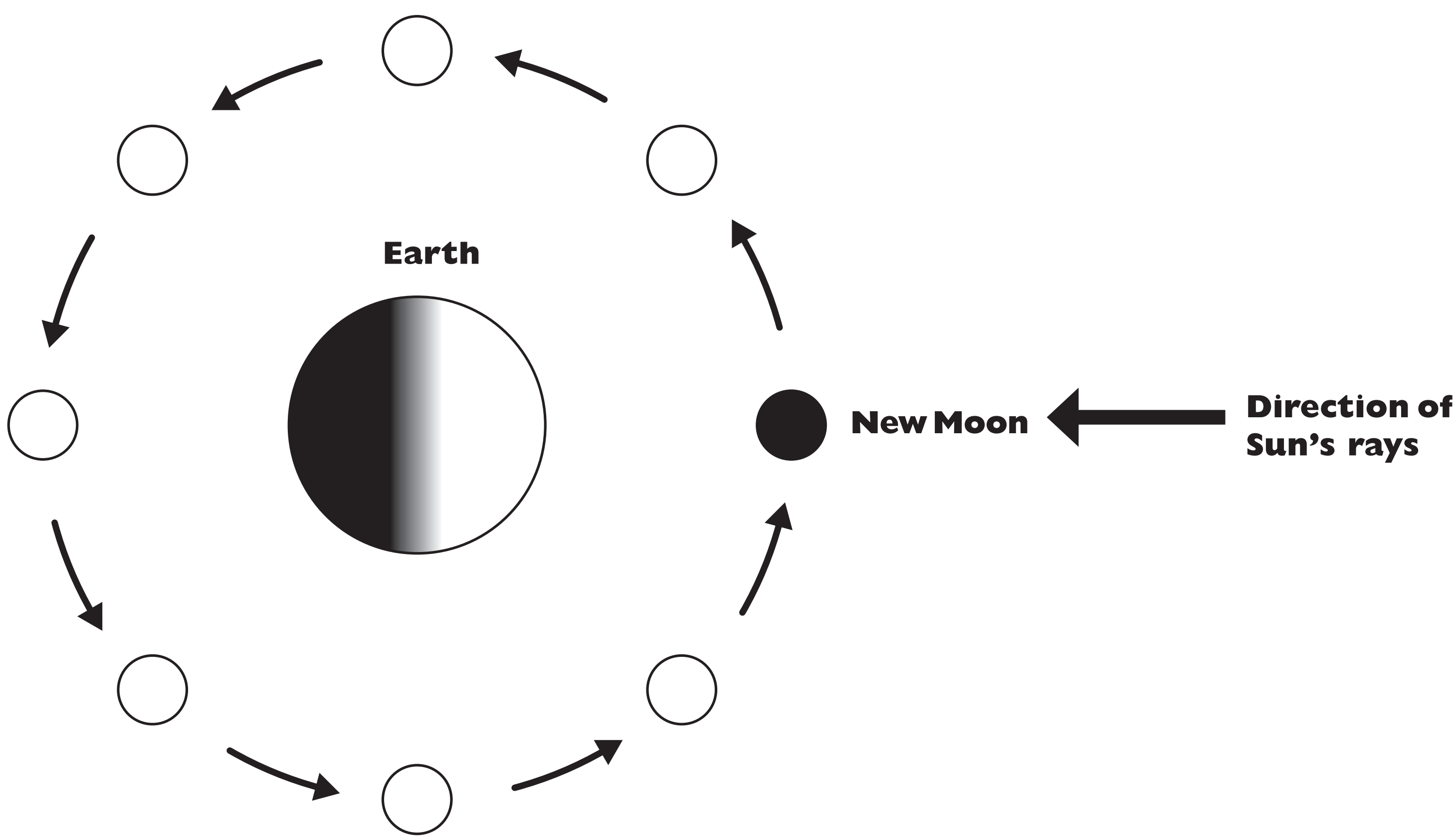
What have I found out (outcomes)

The phases of the Moon relate to the direction of the Sun's rays shining on the Moon.

Children trying this activity can

- Relate the amount of Moon lit up to the direction of the Sun's rays shining on it.
- Accurately sequence the phases of the Moon.

Links Activities 38, 41, 42.



37

Looking the same size

Why should I do this? (objectives)

To understand that the size of an object appears to change with the distance from the viewer. To understand how two objects of different sizes can appear to look the same size.

What do I need? (resources)

A beach ball, a marble, a small table.

Activity

1. Place the beach ball (the Sun) on the table at one end of a room.
2. Hold the marble (the Moon) between finger and thumb of an outstretched hand.
3. Point the marble towards the beach ball and carefully move backwards until the beach ball appears the same size as the marble.
4. Measure the distance from your face to the marble and to the beach ball.
5. Work out how many times further away the beach ball is from you than the marble. The Sun is about 370 times further from the Earth than the Moon. How does your calculation compare with that?

What have I found out (outcomes)

Objects of different sizes can look the same size if they are different distances from an observer. The beach ball would have to be many times larger if it was to be used in a scale model with the Moon the size of a marble.

Children trying this activity can

- Make measurements.
- Work out a proportion.
- Assess the accuracy of their scale model.

Links **Activities 32, 38.**

38

An eclipse of the Sun

Why should I do this? (objectives)

To understand the positions of the Earth, Moon and Sun when a solar eclipse takes place.
To understand why some people see a total eclipse and why others only see a partial eclipse.

What do I need? (resources)

A sheet of paper, globe or football, a tennis ball, a torch or desk lamp.

Activity

1. Shine the lamp onto a sheet of paper. Put the ball on the paper and see its shadow.
2. Raise the ball off the paper towards the lamp and see that the shadow has two parts – a dark centre called the umbra and lighter ring called the penumbra.
3. Shine the light on the globe and move the ball between the globe and the light. Look for a shadow of the ball being cast on the globe.
4. Move the ball between the lamp and the globe until a shadow with an umbra and penumbra appears on the globe. If you were in the umbra on the surface of the globe you would not be able to see the lamp because it is totally eclipsed by the ball. If you were in the penumbra you would see part of the lamp because it is partially eclipsed. People on Earth see a total or partial eclipse of the Sun depending on whether they are in the umbra or the penumbra.

What have I found out (outcomes)

A shadow can have two parts – an umbra and penumbra. People in the Moon's shadow see an eclipse of the Sun when the Moon passes in front of it.

Children trying this activity can

- Make a model of the eclipse of the Sun.
- Distinguish between an umbra and penumbra.
- Understand why a partial or total eclipse can be seen.

Links **Activities 37, 39.**

39

An eclipse of the Moon

Why should I do this? (objectives)

To understand the positions of the Earth, Moon and Sun when a lunar eclipse takes place.

What do I need? (resources)

A globe or football, a tennis ball, a torch or desk lamp.

Activity

1. Hold up the globe in front of the lamp.
2. Move the tennis ball by the globe on the opposite side to the lamp.
3. See the ball pass into the globe's shadow and its surface facing the globe become darker. The ball is now eclipsed by the globe.
4. Notice that before and after the eclipse the side of the ball facing the globe is fully lit meaning that the eclipse takes place at a full Moon. (It does not take place every full Moon because the Earth, Sun and Moon do not line up in this way every month.)

What have I found out (outcomes)

The Moon is eclipsed when it is in the shadow cast into space by the Earth. An eclipse of the Moon occurs at a full Moon. The Moon's orbit around the Earth is at a slight angle to the Earth's orbit around the Sun and this prevents eclipses occurring at every full Moon.

Children trying this activity can

- Make a model of a lunar eclipse.
- Understand that the lunar eclipse take place at the time of a full Moon.

Links Activities 38, 40.

40

Making craters

Why should I do this? (objectives)

To understand how an object falling onto a surface can make a crater.

What do I need? (resources)

A plastic bowl filled with sand, pebbles of different sizes, a ruler, a metre ruler.

Activity

1. Stand the metre ruler on end on the surface of the sand.
2. Hold a pebble one metre above the sand then drop it.
3. Measure the distance across the crater and its depth.
4. Look at the other pebbles in your collection and make predictions about the size and depth of the craters they will make.
5. Test each pebble and measure the size and depth of their craters.
6. Compare your predictions about the craters with the data from the crater making experiment. How good were your predictions?

What have I found out (outcomes)

Larger pebbles make larger craters than smaller pebbles. Heavier pebbles make deeper craters than lighter pebbles. Some small pebbles may make deeper craters than larger pebbles.

Children trying this activity can

- Make predictions and test them.
- Make measurements and record them.
- Draw conclusions from data.

Links Activities 41, 42.

41

Looking at the Moon

Why should I do this? (objectives)

To identify some of the features on the Moon.

What do I need? (resources)

A pair of binoculars, a full Moon or a waxing or waning gibbous Moon.

Activity

1. Look at the Moon with a pair of binoculars.
2. Notice the dark areas. They are lowlands.
3. Notice the lighter areas. They are the highlands.
4. Think of the face of the Moon as the face of a clock and identify these craters. Near the six o'clock position a crater with white rays spreading out from it. This is Tycho. Two craters just south of Tycho – on the left Longomantanus, on the right Maginus. Below them is one of the largest craters. It is called Clavius. Near the ten o'clock position is Aristarchus. Moving in towards the centre from there is another crater with white rays. This is Copernicus. Near the twelve o'clock position is a crater called Plato.

What have I found out (outcomes)

The Moon is divided into upland and lowland areas. Some craters are large enough to be easily seen with binoculars.

Children trying this activity can

- Use a pair of binoculars safely.
- Identify upland and lowland areas on the Moon.
- Identify some large craters.

Links Activities 40, 42.

42

Moon shadows

Why should I do this? (objectives)

To explain why objects viewed on the Moon by binoculars or a telescope change their shadows each night.

What do I need? (resources)

Large lump of Plasticine, torch.

Activity

1. Make the lump of Plasticine into a slab and shape the upper surface so that it appears to have mountains and craters like the surface of the Moon.
2. Predict how you think the shadows of the mountains and craters will appear when you hold the torch above them. This is like sunlight shining on a full Moon.
3. Test your prediction.
4. Predict how you think the shadows will appear when you hold the torch so the light shines across the mountains and craters. This is like sunlight shining on the Moon to make a waxing or waning crescent.
5. Test your prediction.

What have I found out (outcomes)

The mountains and craters have short shadows or no shadows at all when the light shines on them from above. They have long shadows when the light shines across them.

Children trying this activity can

- Make a model of the Moon's surface.
- Make predictions and test them.

Links Activities 36, 41, 78.

43

An image of the Sun

Why should I do this? (objectives)

To understand that there is a safe way to see the Sun in the sky (you must never look at the Sun – it could damage your eyesight).

To look for sunspots.

What do I need? (resources)

A pair of binoculars, a piece of wood about a metre long and 15 centimetres wide, a small piece of card, a larger piece of card, pencil, scissors, sticky paper. Children need adult supervision.

Activity

1. Place one of the large lenses of the binoculars down on the small card. Draw round the lens.
2. Cut out the card disc and stick it over the lens.
3. Stick the other card to one end of the piece of wood. This is the projection screen.
4. Set up the piece of wood on a chair as the diagram shows so that the card faces the Sun.
5. Slide the binoculars about at the other end until you see an image of the Sun on the card.
6. Look at the image to see if sunspots are present on the surface.

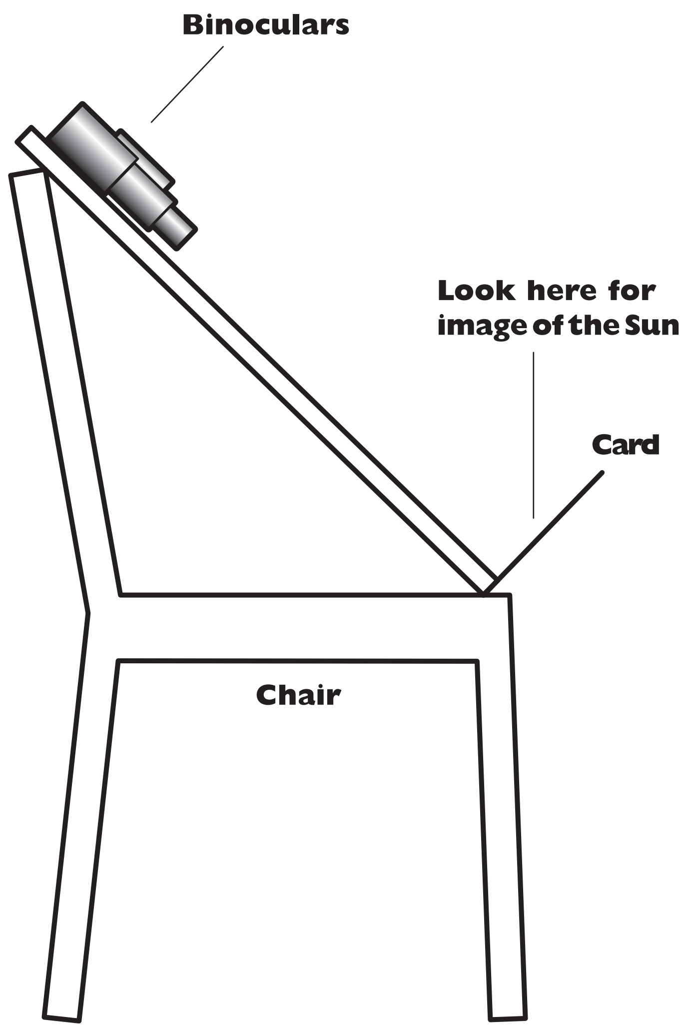
What have I found out (outcomes)

The Sun can be viewed safely by the projection method in which an image of the Sun is formed on a screen.

Children trying this activity can

- Set up equipment to view an image of the Sun.
- Examine an image of the Sun safely.
- Understand that they must never look at the Sun as it can damage their eyesight.

Links Activities 44, 45, 46.



44

The spinning Sun

Why should I do this? (objectives)

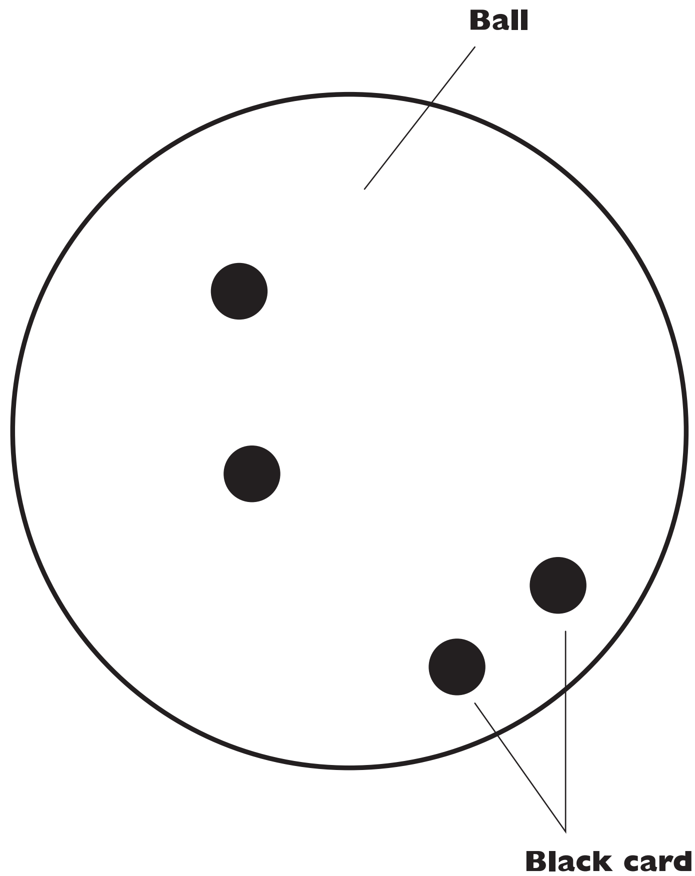
To understand how the Sun was discovered to spin.

What do I need? (resources)

A large yellow ball, small pieces of black card, sticky paper.

Activity

1. Stick the pieces of black card on the ball. You may place some of the spots in pairs.
2. Hold the ball at arm's length, look at the spots then slowly turn the ball from left to right.
3. Notice how the shape of the sunspots appear to change as they emerge from the left, move across in front of you then disappear out of sight. It was these changes in the sunspots that helped scientists to realise that the Sun is spinning.



What have I found out (outcomes)

The sunspots appear to lengthen as they come into view as the Sun spins. They appear to shorten as they are lost from view.

Children trying this activity can

- Make a model of the Sun.
- Make observations on the shape of the sunspots.
- Discover how evidence was gathered to show that the Sun spins.

Links Activities 43, 45, 50.

45

Sunspots and magnetism

Why should I do this? (objectives)

To understand that a sunspot is caused by a magnetic field on the surface of the Sun.

What do I need? (resources)

Iron filings, a clear plastic box, sticky paper, a horseshoe magnet. The iron filings need to be put in the plastic box and sealed in with sticky paper before children use them. Iron filings can be a skin irritant and cause pain if they enter the eyes.

Activity

1. Hold the box level and shake gently to spread out the iron filings evenly.
2. Bring the poles of the horseshoe magnet up under the box and notice how the iron filings behave.
3. Imagine that the iron filings are a cloud of hot gas on the Sun's surface. A cloud of this type is called a solar prominence. They occur near pairs of sunspots.

What have I found out (outcomes)

Iron filings form an arch between the poles of the magnet. The sunspots are like two poles of a magnet. They create a magnetic field which holds hot gases in an arch called a solar prominence.

Children trying this activity can

- Use a magnet and iron filings safely.
- Understand that sunspots have a magnetic field which makes a solar prominence.

Link Activity 43.

46

The Sun and chocolate

Why should I do this? (objectives)

To appreciate the power of the Sun's heat.

What do I need? (resources)

A bar of chocolate, two pieces of card, a box, a magnifying glass. Children need adult supervision.

Activity

1. Break the bar of chocolate into three pieces.
2. Put one piece in a box in the shade.
3. Put the second piece on a card in direct sunlight.
4. Put the third piece on a card in direct sunlight and hold a magnifying glass over it and focus the sunlight onto the chocolate.
5. Predict what will happen to the three pieces of chocolate and test your prediction.

What have I found out (outcomes)

The heat in sunlight is strong enough to melt chocolate. If light is focused on the chocolate, the chocolate melts faster. If the chocolate is kept out of sunlight it does not melt.

Children trying this activity can

- Make predictions and test them.
- Understand that the Sun produces large amounts of heat as well as large amounts of light.

Link Activity 43.

47

A model Solar System

Why should I do this? (objectives)

To appreciate the range of sizes of objects in the Solar System.

What do I need? (resources)

Three peppercorns, two peas, two plums, a currant, an orange, a grapefruit, sand, a beach ball, a table.

Activity

1. Set out the model Solar System in the following way. On the edge of the table set up the beach ball. This is the Sun.

2. Moving across the table top from the beach ball set down a peppercorn (Mercury), a pea (Venus) another pea (Earth), a currant (Mars), sprinkle a few grains of sand (asteroids), set down a grapefruit (Jupiter), an orange (Saturn), a plum (Uranus), another plum (Neptune), a peppercorn (Pluto) and another peppercorn (Sedna).

What have I found out (outcomes)

Some planets are much larger than others and all are small compared to the Sun.

Children trying this activity can

- Set out the objects in the Solar System in the correct order.

Links Activities 49, 52, 53, 54, 55, 56, 58, 59, 60, 61, 63, 65.

48

Looking at the night sky

Why should I do this? (objectives)

To learn the directions of the different parts of the sky. To see how red light helps to keep the eyes adapted to the dark. To distinguish between a star and a planet.

What do I need? (resources)

A compass, a torch, a piece of red transparent paper, scissors, elastic band. A viewing place away from streetlights.

Activity

1. Cut the piece of red paper to fit over the front of the torch. Hold the paper in place with the elastic band.
2. Set up the compass on a flat surface and let it settle. It will have part of its needle coloured. This will be pointing north.
3. Beneath the needle is a card with directions on it. Move the body of the compass carefully so that the north direction lies under the coloured part of the needle. From this you can work out all the other directions on the compass.
4. Look to the northern, western, southern and eastern parts of the sky in turn.
5. Use your torch to look down at the compass and check your positions.
6. Stars will twinkle but planets will shine with a steady light. Look for planets among the stars. You may find up to four.
7. Take off the red paper from the torch and look at the compass then look at the sky. Notice how you see fewer stars.

What have I found out (outcomes)

As you spend more time looking at the sky your eyes become adapted to the dark and you can see more stars. When a red light is used, this does not affect the way your eyes have adapted. If ordinary white light is used your eyes lose their adaptation to the dark.

Children trying this activity can

- Find the directions of the different parts of the sky.
- Tell a planet from a star.
- See how their eyes become adapted to the dark.

Links Activities 18, 49.

49

Twinkle or shine?

Why should I do this? (objectives)

To appreciate why stars twinkle and planets do not.

What do I need? (resources)

Two torches, two pieces of bubble wrap, two friends, a piece of card with a hole 3 cm in diameter, sticky paper.

Activity

1. Put the card over one of the torches so that its light can shine through the hole. Stick the card in place.
2. Set up the torch with the card about 30 cm from your face (this represents a planet) and set up the other torch 5 metres away (this represents a star).
3. Give your friends a piece of bubble wrap (this represents the air in the atmosphere) and ask them to switch on the torches and move the bubble wrap from side to side across the front of the torch. Which light seems to twinkle?
4. Take turns with your friends so that everyone can have a look.

What have I found out (outcomes)

The movement of air in the atmosphere affects the way light from a distant star passes through it and makes the star twinkle. The movement of the air does not affect the light coming from a nearby planet in the same way and the planet does not twinkle.

Children trying this activity can

- Make comparisons.
- Work together to try an experiment.

Links Activities 47, 66, 67, 69.

50

Spinning speeds

Why should I do this? (objectives)

To see that different parts of a planet spin at different speeds.

What do I need? (resources)

A lump of Plasticine the size of an apple, two spent matchsticks.

Activity

1. Shape the Plasticine into a ball. This represents a planet.
2. Decide which parts of the planet are the North and South Poles and mark the position of the equator with one of the matches.
3. Put a match on the equator so that it sticks out.
4. Put the other match about a centimetre from the North Pole so that it too sticks out.
5. Predict how the matchsticks will move when the planet spins.
6. Spin the planet and see which matchstick moves faster.

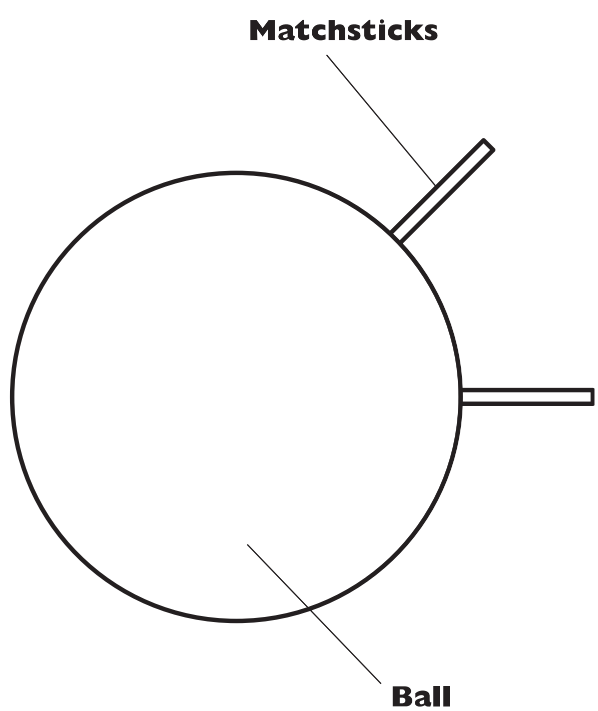
What have I found out (outcomes)

The surface of the planet spins at different speeds. The surface at the equator spins fastest and the surface at the poles spins slowest.

Children trying this activity can

- Make predictions and test them.
- Make observations and comparisons.

Links Activities 19, 44, 51.



51

Spinning and stability

Why should I do this? (objectives)

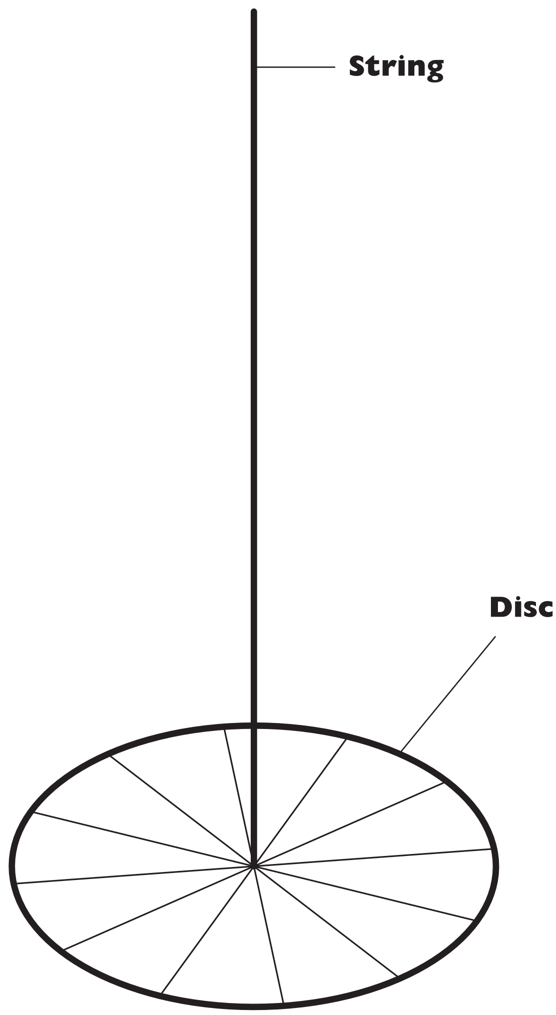
To see that a spinning object in space is more stable than an object that is not spinning.

What do I need? (resources)

A piece of cardboard, scissors, a piece of string 50 cm long, a pencil, a pair of compasses, a ruler.

Activity

1. Tie a large knot in one end of the string.
2. Use the pair of compasses and pencil and ruler to draw a circle with a 7 cm diameter.
3. Cut out the disc and draw a few lines across its diameter. They will help you see the disc spin.
4. Make a hole in the centre of the disc and thread one end of the string through it.
5. Make sure that the disc can spin freely on the knotted end of the string.
6. Do not spin the disc but jiggle it about. Notice how it flips over.
7. Spin the disc and jiggle it about. Does it flip over as easily as before?



What have I found out (outcomes)

A spinning disc does not flip over as easily as one that is not spinning.

Children trying this activity can

- Make a simple piece of equipment.
- Make observations and comparisons.
- Draw a conclusion from comparisons.

Links Activities 19, 44, 50.

52

The tilts of the planets

Why should I do this? (objectives)

To realise that planets are tilted in different ways.

What do I need? (resources)

Plasticine, nine cocktail sticks, a protractor.

Activity

1. Make nine balls of Plasticine. They can all be the same size for this activity although the planets vary greatly in size.
2. Stick the balls on the cocktail sticks.
3. Make a Plasticine base for each stick.
4. Place each stick in its base so that the axis of each planet is vertical.
5. Use the protractor to measure the angle of tilt from the vertical for each planet. They are – Mercury 0°, Venus 2°, Earth 23°, Mars 25°, Jupiter 3°, Saturn 26°, Uranus 97°, Neptune 28° and Pluto 62°.
6. Set the axis of each planet at its angle of tilt.

What have I found out (outcomes)

There is a wide range of angles at which the planets are tilted.

Children trying this activity can

- Use a protractor to measure angles.
- Compare the angles at which the planets tilt.

Links Activities 25, 47.

53

A week on Mercury

Why should I do this? (objectives)

To appreciate how slowly Mercury spins.

What do I need? (resources)

Calculator (optional).

Activity

1. Mercury spins 58 times more slowly than the Earth. This means a day on Mercury is equal to 58 Earth days. How many Earth days are there in a week on Mercury?
2. Express a week on Mercury in terms of years, months and days on Earth.

What have I found out (outcomes)

A week on Mercury is over a year on Earth.

Children trying this activity can

- Perform calculations.
- Compare the spins of Mercury and Earth.

Links Activities 19, 54.

54

A greenhouse on Venus

Why should I do this? (objectives)

Venus has a thick atmosphere, which produces a “greenhouse effect” on the planet. This activity helps the understanding of what the “greenhouse effect” means.

What do I need? (resources)

Two small beakers of water, a measuring cylinder, a thermometer, a clock, a glass jar, a sunny windowsill.

Activity

1. Pour the same amount of water into each beaker.
2. Take the temperature of the water in each beaker.
3. Set up the beakers on a sunny windowsill.
4. Put the glass jar over one beaker. This is the greenhouse.
5. Leave the beakers for an hour and then take the temperature of the water again. How do the temperatures compare?
6. Predict the temperature of the water in the two beakers if they were left for two hours. Test your prediction.

What have I found out (outcomes)

The glass in a greenhouse traps heat from the Sun and raises the temperature of the surroundings. The longer the Sun shines on a greenhouse the higher the temperature rises.

Children trying this activity can

- Measure volume, temperature and time.
- Make a prediction and test it.

Links Activities 7, 14, 55.

55

The speedy Earth

Why should I do this? (objectives)

To appreciate how fast the Earth is moving though space.

What do I need? (resources)

A stop clock.

Activity

1. The Earth travels through space at almost 3 kilometres per second. Work out how far it will have travelled through space by the time you have sung the most widely sung song on the planet – happy birthday.
2. Start the stop clock and begin singing.
3. When you have finished stop the clock, multiply the time in seconds by three to find how far the Earth has travelled.
4. The Earth travels 10,400 kilometres in an hour. Work out how far it travelled while you were sleeping last night.

What have I found out (outcomes)

The Earth travels quickly in its orbit around the Sun.

Children trying this activity can

- Perform simple calculations.

Links Activities 24, 56.

56

Mars – the red planet

Why should I do this? (objectives)

To understand why Mars appears red. To understand that water is needed for rusting to take place.

What do I need? (resources)

Gardening gloves, wire wool, scissors, two dishes, sand, measuring jug, water.

Activity

1. Put the same amount of sand in each dish.
2. Put on the gloves and cut up the wire wool into pieces about two centimetres long.
3. Add the same amount of wire wool to each dish.
4. Mix the wire wool and sand together.
5. Add water to one dish until the mixture is just covered.
6. Leave the dishes on a shelf. Check them every day to look for signs of change. If the wet dish has dried out add a little more water.

What have I found out (outcomes)

The iron in the dish with water rusts and turns the mixture red. The iron in the dry dish does not rust and the colour of the mixture remains the same.

Children trying this activity can

- Use simple equipment and materials safely.
- Perform a fair test.

Links Activities 57, 58.

57

Life on Mars?

Why should I do this? (objectives)

To understand how a test for living things can be made on a planet surface. To compare a living process with a chemical process.

What do I need? (resources)

Three plastic jars, three labels, yeast, baking powder, sand, a teaspoon, sugar, a cup, a bowl, warm water, measuring cylinder.

Activity

1. Add sand to each jar until it is about one third full. Make sure that each jar has the same amount of sand.
2. Add two teaspoons of yeast to the first jar, stir it into the sand and label the jar.
3. Add two teaspoons of baking powder to the second jar, stir it into the sand and label the jar. Add nothing to the third jar and label it.
4. Put half a cupful of sugar into the bowl and add two cups of warm water. Stir up the mixture until the sugar dissolves.
5. Add the same amount of sugar solution to each jar and watch for a sign of change.

What have I found out (outcomes)

There was no change in the third jar. There was an immediate and fast change in the second jar indicating a chemical reaction was taking place. There was a slower change which lasted much longer in the first jar. This indicates a living process. The yeast feed on the sugar, respire and produce carbon dioxide and breed so the reaction lasts a long time.

Children trying this activity can

- Make a fair test.
- Compare changes.

Links **Activities 7, 78.**

58

Flying between the asteroids

Why should I do this? (objectives)

To understand the problem of travelling through the asteroid belt.

What do I need? (resources)

A large lump of Plasticine, a reel of thread, scissors, sticky tape, a piece of wood about 30 cm long and 10 cm wide.

Activity

1. Divide up the lump of Plasticine into about 12 large and small pieces and keep an extra piece for later. These are the asteroids.
2. Cut the threads to about the same length and stick the end of each one into a lump of Plasticine.
3. Attach the other end of each thread to the piece of wood with sticky paper. Spread out the places where the threads are attached to the wood.
4. Hold the wood so that the asteroids hang down from it. You have made part of the asteroid belt.
5. Make a spaceship out of the last piece of Plasticine. Put the spaceship on the end of the cocktail stick.
6. Try and guide your spaceship through the asteroid belt without making any collisions.

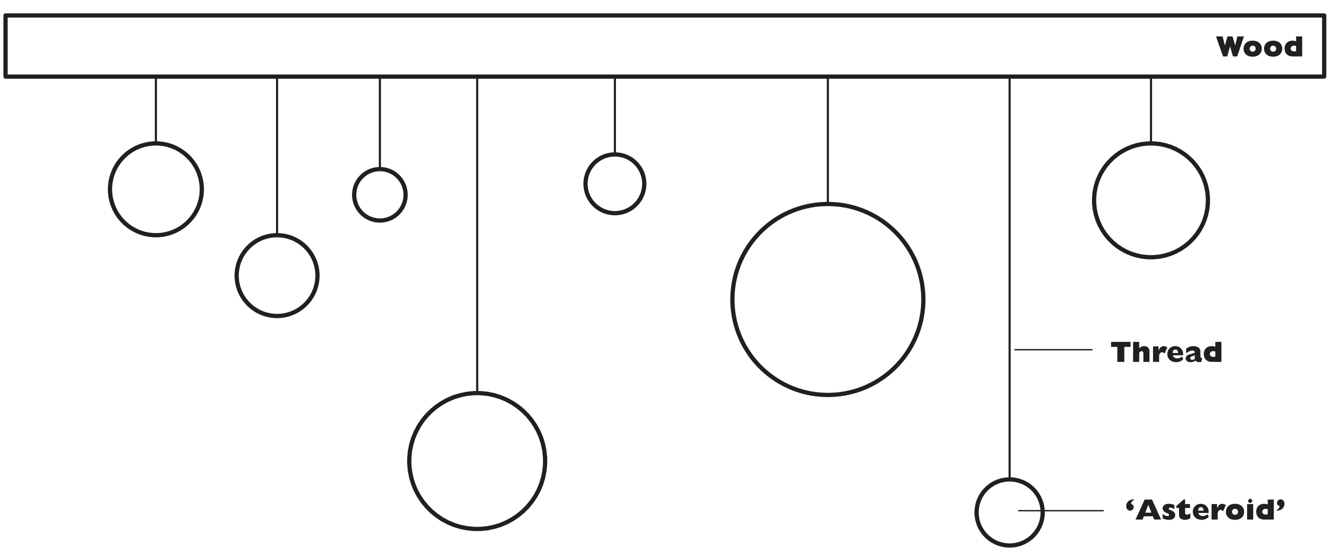
What have I found out (outcomes)

The asteroid belt is made up of asteroids of different sizes that appear to hang in space. Care must be taken when steering a spaceship through the asteroid belt.

Children trying this activity can

- Make a model of the asteroid belt.
- Assess the difficulty of moving through the asteroid belt.

Links **Activities 47, 59, 62.**



59

Landing on Jupiter

Why should I do this? (objectives)

To understand that Jupiter does not have a solid surface.

What do I need? (resources)

A tall clear plastic beaker, warm water, washing up liquid, a long spoon, a small pebble.

Activity

1. Pour the warm water into the beaker and add some washing up liquid.
2. Stir up the mixture with the spoon until there is a foam above the liquid. This is like the surface of Jupiter.
3. The pebble represents a space probe. Drop it onto the surface of Jupiter. What happens?

What have I found out (outcomes)

When a space probe reaches the surface of Jupiter it falls through it as the surface is a gas.

Children trying this activity can

- Make a simple model of Jupiter's surface.
- Make an observation.

Links **Activities 60, 79.**

60

Turn an apple into Saturn

Why should I do this? (objectives)

To see how the appearance of Saturn changes as it moves round the Sun.

What do I need? (resources)

A piece of card, a pair of compasses, pencil, ruler, an apple about 6 cm wide, scissors, sticky paper.

Activity

1. Draw a circle 14 cm in diameter on the card.
2. Inside this circle draw another circle 6 cm in diameter.
3. Cut out the card disc and cut out its centre.
4. Put the card ring around the apple.
5. Stick the ring in place with sticky paper. You have now turned the apple into Saturn.
6. As Saturn moves in its orbit around the Sun the tilt of its rings appears to change to us viewing the planet from Earth. Sometimes the rings seem tilted towards us and sometimes they do not seem to tilt at all. Model this in the following way:
7. Hold the apple by its stalk and raise it up to your eye level.
8. Tilt Saturn towards you and see its rings.
9. Tilt Saturn back until its rings face straight up and down. How do they appear to you now.

What have I found out (outcomes)

Saturn sometimes looks as if it does not have any rings. This occurs when the edges are facing you and they are difficult to see.

Children trying this activity can

- Make a model Saturn.
- See how the appearance of the rings changes as the tilt of the planet seems to change.

Links Activities 31, 61.

61

Uranus – a planet on its side

Why should I do this? (objectives)

To compare the tilt of Uranus with that of Earth. To compare how Uranus travels round the Sun with the way the Earth travels round the Sun.

What do I need? (resources)

A beach ball on a table, a globe mounted on its base at the correct angle of tilt, a large yellow ball (a model Sun), a small table.

Activity

1. Place the ball on a table.
2. Hold the globe so that its base is horizontal and it tilts at 23 degrees to the vertical.
3. Point the top of the globe in a certain direction and move round the ball on the table keeping the top of the globe pointing in the same direction.
4. Make one orbit of the Sun.
5. Tilt the globe now until it appears to be lying on its side. This is approximately the position of Uranus.
6. Point the North Pole in one direction and keep it pointing in the same direction as you make another orbit of the Sun.
7. Notice that there are times when the whole of the Northern Hemisphere is facing the Sun and times when the whole of the Southern Hemisphere is facing the Sun.

What have I found out (outcomes)

The tilt of Uranus is much greater than the tilt of the Earth. The whole hemispheres sometimes face towards the Sun and sometimes away from it.

Children trying this activity can

- Investigate the passage of Uranus around the Sun by making a simple model.

Links Activities 62, 63.

62

Finding dust rings

Why should I do this? (objectives)

To understand how Uranus' dust rings were discovered.

What do I need? (resources)

A large comb (represents dust rings) and a small torch (represents a distant star).

Activity

1. Set up the torch a few metres away in a dark room.
2. Close one eye and look at the torch.
3. Hold up the comb in front of your face and move it from right to left. This represents how the rings moved in front of a distant star as Uranus made its orbit. How does the light from the torch change?

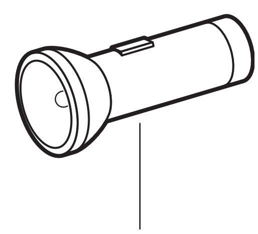
What have I found out (outcomes)

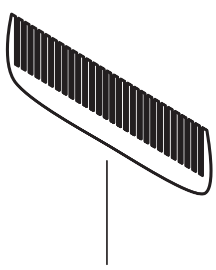
The dust rings blocked the light for a moment as they passed by and made the star light flicker.

Children trying this activity can

- Make a use simple model to show how a discovery was made.

Links Activities 58, 61.





63

Take your partner

Why should I do this? (objectives)

To understand how Pluto and Charon move.

What do I need? (resources)

A friend.

Activity

1. Cross your hands and get your friend to cross their hands too.
2. Hold each other's hands.
3. Spin round each other. This is how Pluto and Charon spin round each other.

What have I found out (outcomes)

Pluto and Charon spin round each other.

Children trying this activity can

- Perform a simple dance to show how Pluto and Charon move.

Links Activities 36, 65.

64

The comet's tail

Why should I do this? (objectives)

To understand how the tail of the comet always points away from the Sun.

What do I need? (resources)

A hair drier, a lollipop stick, white Plasticine, white pieces of string 10 cm long. Children need adult supervision.

Activity

1. Make the Plasticine into a ball. This is the body of the comet.
2. Stick one end of each string into the comet. Keep all the strings in one half of the comet's body.
3. Put the comet's body on the lollipop stick.
4. Turn on the hair drier (this represents the Sun) and set it on the lowest heat. The blast of air from the hair drier represents the solar wind.
5. Move the comet towards the Sun and note which way the solar wind blows the tail.
6. Move the comet away from the Sun and note which way the solar wind blows the tail.

What have I found out (outcomes)

The comet's tail always points away from the Sun. It moves ahead of the body of the comet as the comet moves away from the Sun.

Children trying this activity can

- Make a simple model of a comet.
- Discover that the tail sometimes travels in front of the body of the comet.

Links Activities 58, 65.

65

The home of the comets

Why should I do this? (objectives)

To understand where comets come from.

What do I need? (resources)

A balloon, old newspapers, scissors, wallpaper paste (non-allergic), pin, black paint, white paint, large paint brush, small paint brush, thread, sticky paper, a piece of card, pair of compasses, pencil, small piece of Plasticine.

Activity

1. Blow up a balloon until it is about 20 cm across its widest part.
2. Cut up strips of newspaper, mix water with the wallpaper paste and use the newspaper and paste to make papier mache covering over three quarters of the balloon.
3. Let the paper coat set hard then pop the balloon and cut the paper coat until you make a hemisphere.
4. Paint the inside and outside of the coat black.
5. When the black paint has dried paint lots of white dots on it to represent the bodies of comets. This represents one half of the Oort cloud.
6. Make a disc of card 10 cm in diameter. Put a hemisphere of Plasticine at the centre to represent the northern hemisphere of the Sun.
7. You may wish to add more pieces of Plasticine to the card to represent the planets.
8. Put one end of the thread in the Plasticine and stick the other end to the 'roof' of the Oort cloud with sticky paper.

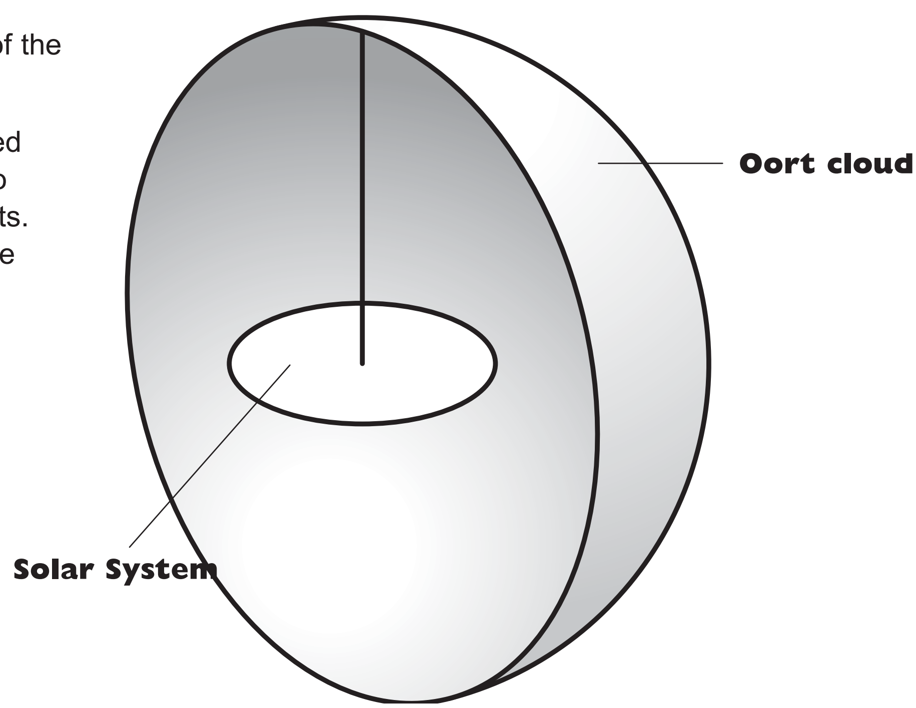
What have I found out (outcomes)

The Solar System is surrounded by a spherical shaped cloud of comets.

Children trying this activity can

- Make a model of the Oort cloud enclosing the Solar System.

Links Activities 47, 64.



66

Looking for patterns

Why should I do this? (objectives)

To understand how constellations help you to look at the sky.

What do I need? (resources)

A piece of black card, some sugar crystals, a friend.

Activity

1. Sprinkle the sugar crystals on the card. They represent stars in the night sky.
2. Look at the crystals and find some that you can link together to form a picture.
3. Draw pictures of your 'constellations' and see if a friend can recognise them in your night sky.

What have I found out (outcomes)

The stars in the sky can be studied more easily if they are divided up into groups called constellations.

Children trying this activity can

- See how making constellations helps divide up the night sky.

Links Activities 49, 67, 68.

67

Recognising constellations

Why should I do this? (objectives)

To recognise some constellations in the night sky.

What do I need? (resources)

Four pieces of black card, pencil, scissors, window, sticky paper.

Activity

1. Look at the pictures of these constellations opposite. A, B, C and D can be seen in the Northern Hemisphere, while C, D, E and F can be seen in the Southern Hemisphere.
2. Mark the positions of the stars of the four constellations seen in your hemisphere on each of the cards.
3. Make holes at the marks so that light can shine through.
4. Stick the cards on a window and look at the constellations from time to time to help you remember them.
5. On a clear night look for the constellations in the sky.

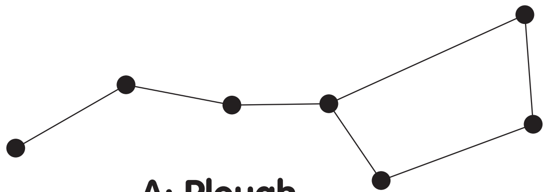
What have I found out (outcomes)

A constellation is an arrangement of stars. Some can be seen in both hemispheres.

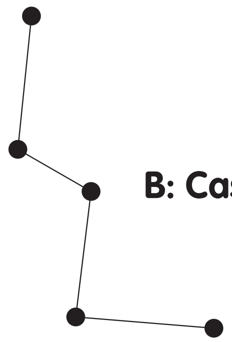
Children trying this activity can

- Make constellations on black card and learn the pattern of the stars in each one.
- Recognise constellations in the night sky.

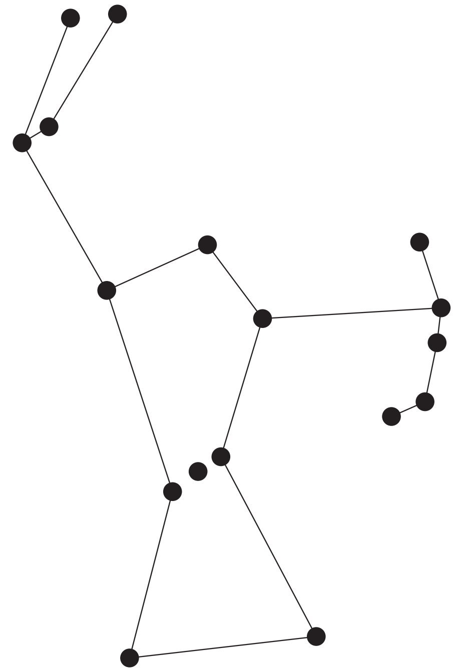
Links Activities 49, 66, 67, 70.



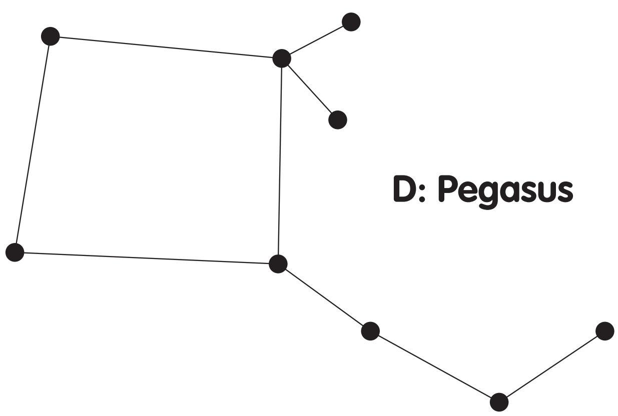
A: Plough



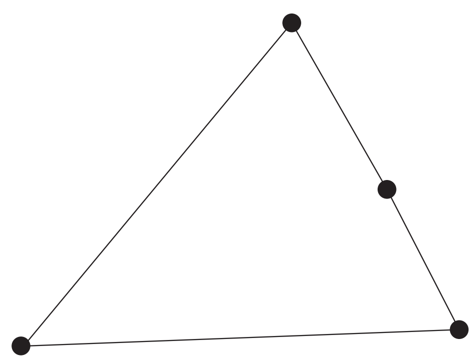
B: Cassiopeia



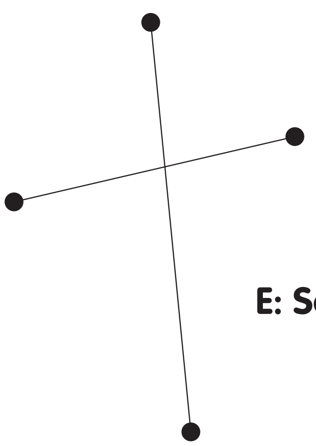
C: Orion



D: Pegasus



F: Triangulam Australe



E: Southern Cross

68

Light bulb constellations

Why should I do this? (objectives)

To understand that all the stars in a constellation are not at the same distance from the Earth.

What do I need? (resources)

Three batteries, three switches, nine wires, three bulbs in bulb holders, three blocks for supporting the bulbs.

Activity

1. Make three simple circuits. In each one there is a battery, switch and bulb.
2. Set the three bulbs in a line but several centimetres from each other.
3. Darken the room and look at the constellation from a few metres away.
4. Move one bulb a little closer to you and one a little further away.
5. Look at the constellation again. Does it still form a line?
6. Make a triangle constellation and put the bulbs at different distances from you.

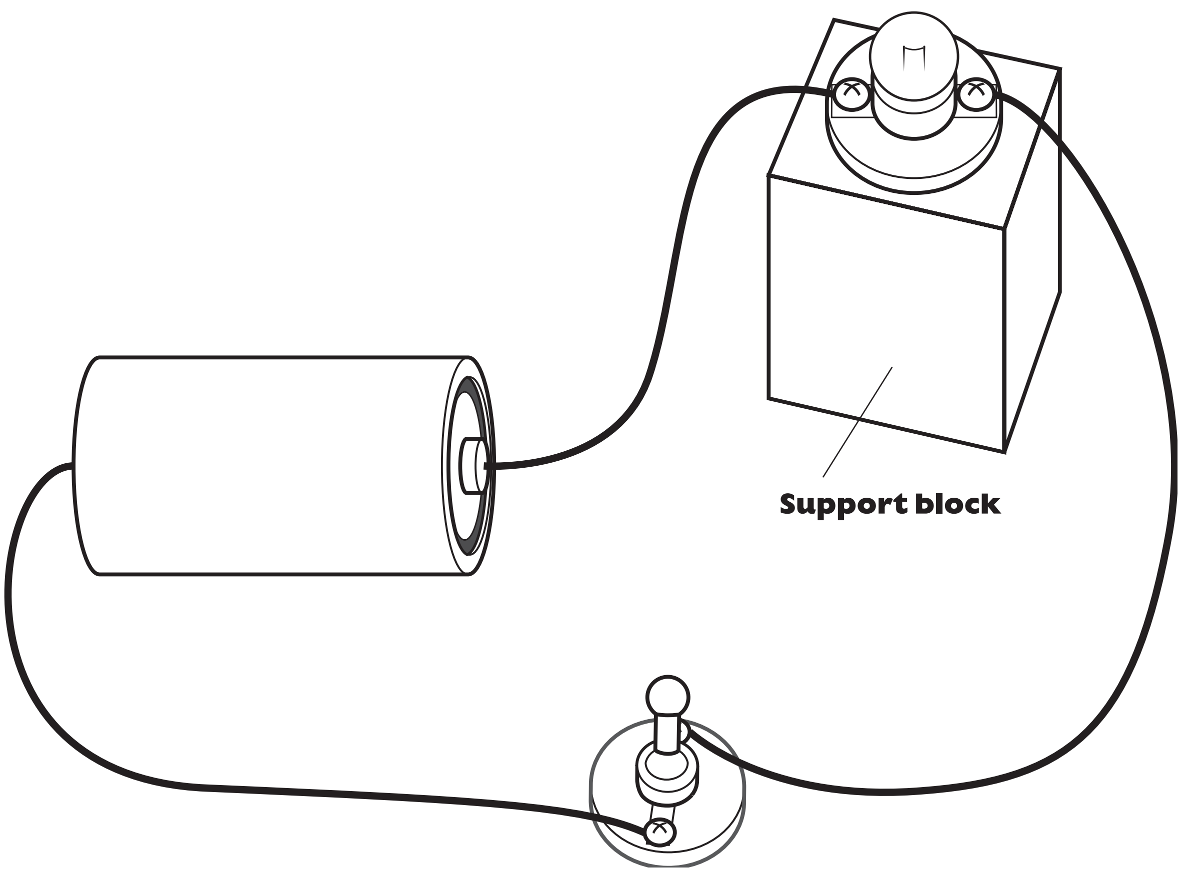
What have I found out (outcomes)

Stars in a constellation can be at different distances to the observer.

Children trying this activity can

- Make simple circuits that work.
- See that stars in constellations can be at different distances from the viewer.

Links Activities 67, 69.



69

Dim stars, bright stars

Why should I do this? (objectives)

To find the relationship between star brightness and the distance at which it can be seen.

What do I need? (resources)

A torch, a black card, a pin and pencil, a ruler and long tape measure.

Activity

1. Make a constellation in the card from the first letter of your name.
2. Make pin holes then put the card in front of the torch and see how far you had to move back before the stars could not be seen.
3. Make the holes 2 mm across and repeat the previous step.
4. Predict how far you would have to move back if the holes were 3 mm. Test your prediction.
5. Predict how far you would have to move back if the holes were 5 mm. Test your prediction.

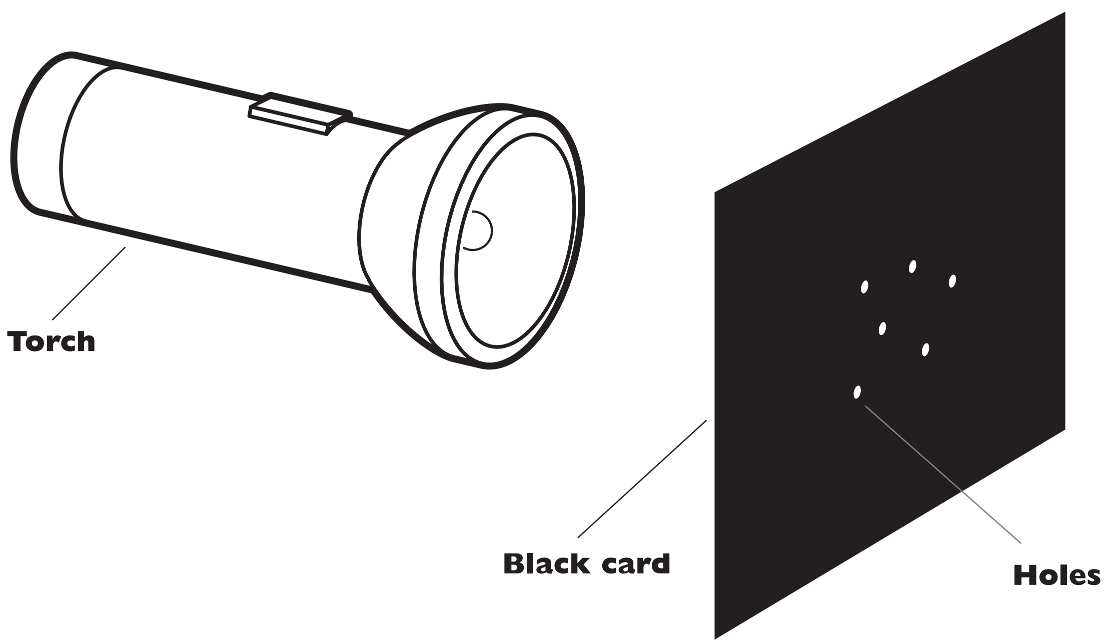
What have I found out (outcomes)

Bright stars can be seen from greater distances than dim stars.

Children trying this activity can

- Make predictions and test them.
- Record their data in a table.

Links Activities 49, 68.



70

Galaxy in a coffee cup

Why should I do this? (objectives)

To see how stars are arranged in a spiral galaxy.

What do I need? (resources)

A coffee cup, instant coffee, a teaspoon, warm water, cream. Adult supervision is needed if the water is boiled and the coffee is to be drunk.

Activity

1. Put some warm water in a cup.
2. Put a teaspoon of coffee granules in the water and stir until they dissolve. Stir the water just one way.
3. Put cream in the teaspoon until it is about a quarter full.
4. Carefully and slowly tip the cream into the centre of the swirling coffee.
5. Notice how the cream spreads out like the stars in a spiral galaxy.

What have I found out (outcomes)

A spiral galaxy has arms which curl round.

Children trying this activity can

- See the shape of a spiral galaxy in a cup of coffee.

Links Activities 67, 71.

71

How galaxies move

Why should I do this? (objectives)

To understand how galaxies move as the universe expands.

What do I need? (resources)

A blue balloon, a yellow felt tip pen.

Activity

1. Put some spots to represent galaxies on the uninflated balloon with the felt tip pen.
2. Imagine that you are in one of the galaxies. Predict what might happen to the galaxies around you as the universe expands (the balloon blows up).
3. Blow up the balloon a little and test your prediction.
4. Blow up the balloon some more and see what happens to the galaxies.

What have I found out (outcomes)

The galaxies move apart as the universe expands.

Children trying this activity can

- See that as the universe expands the galaxies move further apart.

Link Activity 70.

72

The force of gravity

Why should I do this? (objectives)

To understand that gravity is a force that acts from the centre of the Earth.

What do I need? (resources)

A ball, a felt tip pen, a plank and some blocks or books, a spade, a flower bed.

Activity

1. Hold the ball out at arm's length then let it go. A force can make a stationary object move. Does gravity do this?

2. Throw the ball up into the air. A force can make a moving object change direction. Does gravity do this?

3. Put two marks on the ball with a felt tip pen. Put the second mark on the opposite side of the ball to the first mark. Put some blocks under one end of the plank to make a ramp. Place the ball at the top of the ramp and let it go. Watch the spots – do they flash by more quickly as the ball rolls down the slope? A force makes a moving object speed up. Does gravity do this?

4. The gravity of the Earth acts from its centre not its surface. If you dig a hole and drop a ball over it, where will the ball go? Test your prediction.

What have I found out (outcomes)

Gravity makes a stationary object move, a moving object change direction and speed up and pulls it down a hole.

Children trying this activity can

- Understand the characteristics of a force.
- Understand that gravity is a force.

Links Activities 24, 32, 73, 74.

73

Gravity and newtons

Why should I do this? (objectives)

To understand the relationship between gravity and weight.

What do I need? (resources)

A small apple, a range of everyday objects, a force meter measuring in newtons.

Activity

1. The unit of force is the newton. It is about the same as the weight of a small apple. Pick up a small apple and put it in the palm of your hand. Feel the force of one newton pressing down on your skin.
2. Look at one of your everyday objects and guess its weight in newtons. Put it in your hand and estimate its weight in newtons. Does your estimate match your guess? Write down your estimate.
3. Repeat the previous step with the other everyday objects.
4. Measure the weight of the objects using a force metre which measures in newtons. How accurate were your estimates?

What have I found out (outcomes)

Gravity pulls on everything on the Earth and gives it its weight. Weight is measured in newtons.

Children trying this activity can

- Compare estimates with actual results.
- Use a force meter.

Links Activities 72, 76.

74

Gravity and satellites

Why should I do this? (objectives)

To understand how gravity holds a satellite in place around a planet.

What do I need? (resources)

A table tennis ball, a piece of string, sticky paper.

Activity

1. Stick one end of the string to the ball. The ball represents a satellite.

2. Hold the other end of the string in your hand. Your hand represents the Earth.

3. Swing the ball so that it moves in a circle round your hand. The tug that you make on the string is like the pull of gravity on a satellite.

4. What do you think would happen if gravity was suddenly switched off by you letting go of the string? Make a prediction and test it. Repeat the test a few times before you make a conclusion.

What have I found out (outcomes)

Gravity pulls a satellite round the Earth. If gravity was not present the satellite would fly off in a straight line.

Note: moons are pulled round planets and planets are pulled round the Sun by the force of gravity.

Children trying this activity can

- Repeat an experiment and compare results.

- Draw a conclusion from their observations.

Links **Activities 24, 32, 72.**

75

The balloon rocket

Why should I do this? (objectives)

To understand how a rocket can oppose the force of gravity.

What do I need? (resources)

A long balloon (this represents a rocket engine), a drinking straw cut into two equal lengths, sticky paper, a long thin piece of string, a small piece of wood, a friend.

Activity

1. Thread the two pieces of straw onto the string.
2. Stick one end of the string to the piece of wood with the sticky paper and put the wood on the floor.
3. Tie the other end of the string to a door handle or similar object about a metre or more above the ground.
4. Blow up the balloon and when it is hard, pinch the neck. Get your friend to stick the front and back ends to the two lengths of straw with sticky paper.
5. Make the string tight by holding the end of the string on the wood firmly and pulling a little.
6. Let go of the neck of the balloon. The force of the air leaving the balloon is balanced by a reaction force which pushes the balloon in the opposite direction. Is this force stronger than gravity?

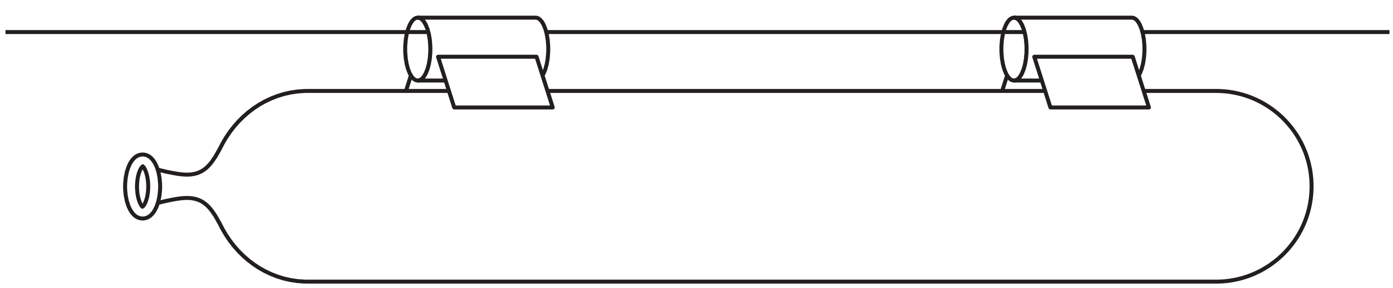
What have I found out (outcomes)

The force generated by a rocket engine is greater than gravity and allows the rocket to move away from the surface of the Earth.

Children trying this activity can

- Use simple materials safely.
- Work together to perform an experiment.
- Demonstrate how a rocket engine works.

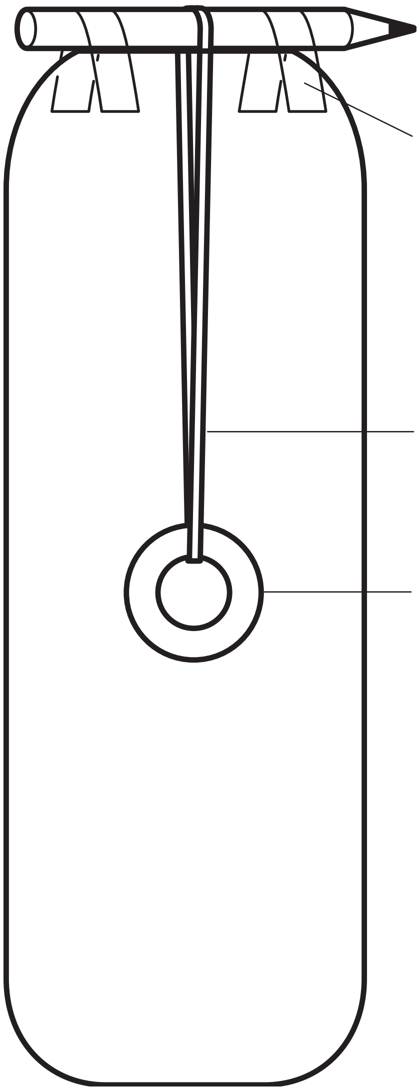
Links Activities 74, 79, 80.



Balloon rocket

76

Weightlessness



Why should I do this? (objectives)

To understand how objects in a spacecraft going round the Earth are weightless.

What do I need? (resources)

A tall plastic bottle with the neck removed (an adult must cut off the top), a pencil, a thin elastic band, a small weight from kitchen scales, sticky paper, safety glasses.

Activity

1. Put on your safety glasses.
2. Stick the small weight to the elastic band.
3. Hook the elastic band around the pencil and rest the pencil across the top of the bottle. Hold it in place with sticky paper.
4. Notice how the weight pulls on the elastic band and stretches it.
5. Hold up the bottle then move it down quickly while watching the weight and elastic band. Does the elastic band stretch more or become shorter for a moment?
6. You may wish to repeat the experiment a few times.

What have I found out (outcomes)

An object inside a falling object loses weight. This is why the elastic band became shorter for a moment. A spacecraft in orbit round the Earth is actually falling round it so the objects inside, including the crew are weightless.

Note that far out in space where there are no planets or stars there is no pull of gravity and an object placed there is weightless too.

Children trying this activity can

- Make careful observations.
- Draw conclusions from their observations.

Links Activities 73, 77, 78.

77

How weight changes

Why should I do this? (objectives)

To realise that the pull of gravity of a planet or moon give the objects on it their weights.

What do I need? (resources)

Kitchen scales, bag of flour, two paper plates, seven small apples, a plastic bag.

Activity

1. Weigh out 600 g of flour and put it on a plate.
2. Weigh out 100 g of flour and put it on the other plate.
3. Hold the first plate in your left hand, and the second plate in your right hand. And feel them pushing down. If you were on the Moon, the pull of gravity is six times smaller than on the Earth so the quantity of flour in your left hand would weigh the same as the quantity in your right hand.
4. Put six small apples in the bag and hold it in your left hand. Hold the other apple in your right hand. The bag of apples pulls on your hand with a force of about six newtons. If it were on the Moon it would pull with the same force as the apple in your right hand.
5. The pull of gravity on Mars is three times less than that on Earth. How could you compare the pulling force in newtons?

What have I found out (outcomes)

The pull of gravity gives objects their weight. Planets and moons have different pulls of gravity so if the same object was placed on each one in turn it would have a different weight at each place.

Children trying this activity can

- Compare forces and weights.
- Use a previous experiment to prepare a new demonstration.

Links Activities 76, 78.

78

Jumping on the Moon and Mars

Why should I do this? (objectives)

To see how gravity on the Moon or Mars can affect movement there.

What do I need? (resources)

A metre rule, a friend.

Activity

1. Ask your friend to hold a metre rule vertically with one end resting on the ground.
2. Make a standing jump next to the metre rule and ask your friend to see how high you jumped.
3. Repeat the previous step a few times and calculate an average.
4. The pull of gravity is six times less on the Moon than it is on Earth. How high do you think you could jump on the Moon?
5. The pull of gravity is three times less on Mars than it is on Earth. How high do you think you could jump on Mars?

What have I found out (outcomes)

People can jump higher on the Moon and Mars than they can on the Earth.

Children trying this activity can

- Work together on an experiment.
- Repeat measurements.
- Perform simple calculations.

Links Activities 42, 57, 77.

79

Testing parachutes

Why should I do this? (objectives)

When Apollo spacecraft return to Earth they used parachutes to help them land. What difference do parachutes make to falling objects?

What do I need? (resources)

Plastic shopping bags, card, a pair of compasses, ruler, pencil, scissors, a reel of thread, sticky paper, large paperclips.

Activity

1. Use the pair of compasses, ruler and pencil to draw a circle with a 14 cm diameter on the card.
2. Cut out the circle. Place it over a sheet of plastic from a shopping bag and cut out a disc. This will form the canopy of a parachute.
3. Cut four threads to the same length.
4. Stick one end of each thread to the canopy. Make sure the ends are evenly spaced around the edge of the canopy.
5. Join the other ends together with a piece of sticky paper.
6. Add a paperclip to these ends to act as a weight.
7. Hold up a paperclip and let it drop.
8. Hold up your parachute and let it drop.
9. Repeat the previous step a few times and assess how gently the parachute and paperclip landed compared to the paperclip on its own.
10. Design and make a parachute that falls more gently than the one you have just made.

What have I found out (outcomes)

Parachutes slow down falling objects.
Note: the force acting against gravity on the parachute is air resistance. Parachutes are used on space probes visiting other planets. The planet's atmosphere offers resistance to the parachute and can allow the probe to land without damage.

Children trying this activity can

- Make a fair test.
- Use information from experiments in designing new equipment.

Links Activities 59, 72, 75.

80

Glider flights

Why should I do this? (objectives)

The Space Shuttle acts as a glider as it comes back into land after a space flight. It has movable surfaces which are used to control its flight. How do the surfaces of a glider affect the way it flies?

What do I need? (resources)

A sheet of paper, a ruler, a pencil, scissors.

Activity

1. Look at the picture of a model glider opposite.
2. Make a photocopy of the glider.
3. Cut out your glider.
4. Fold up the nose of the glider so that it comes to form a thick part to the front of the wings.
5. Bend up the ends of the wing along lines C and D.
6. Cut into the backs of the wings to make flaps E and F.
7. Bend the glider along line A and B so the wings and tail stick upwards a little.
8. Hold your glider by the tail, point it down slightly and let it go.
9. Repeat the previous step with the flaps pushed down, flaps pushed up, one flap pushed up and one flap pushed down. What do you find?
10. Can you make your glider go where you want it to go?
11. Can you make a glider that you can control better?

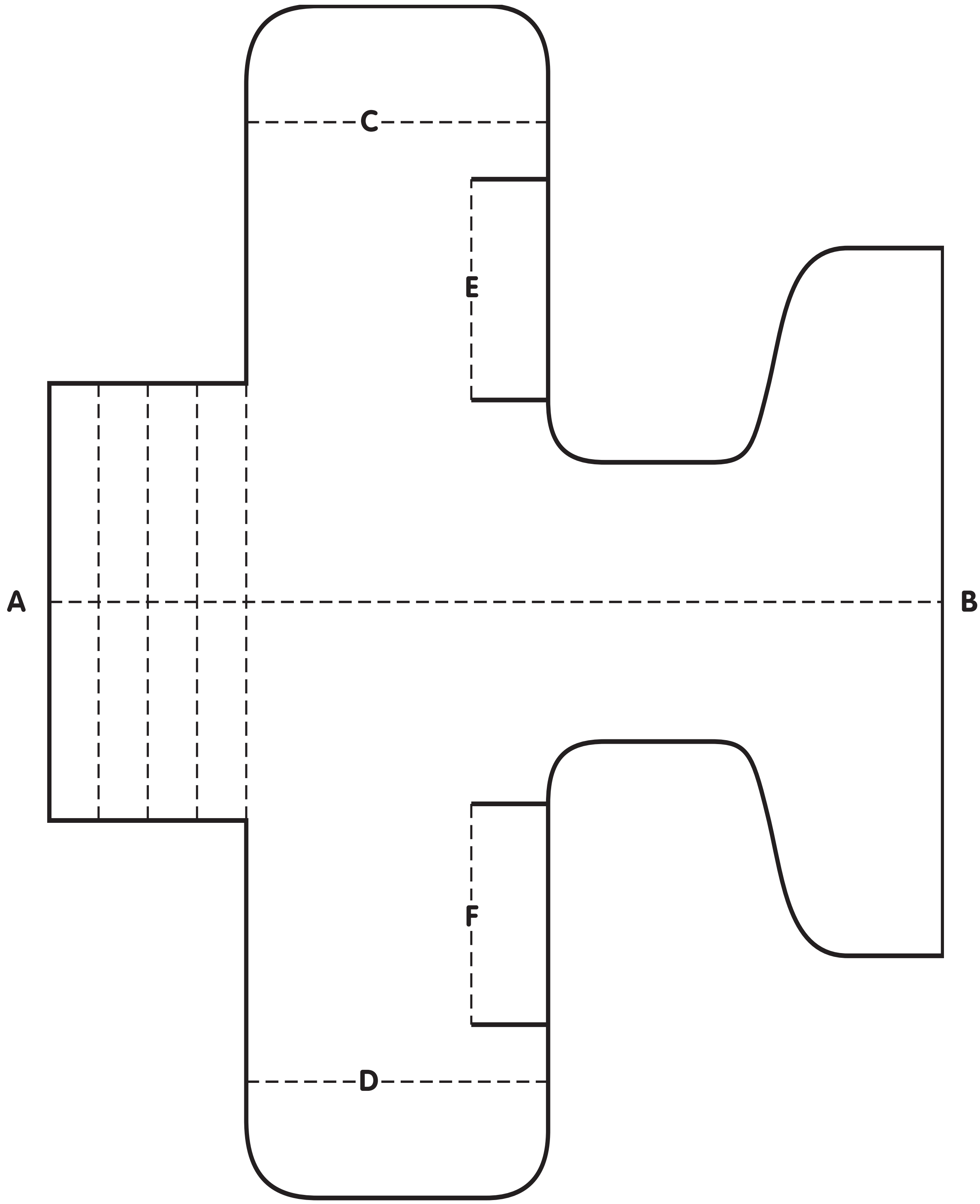
What have I found out (outcomes)

The flight of the glider can be changed by changing the positions of some of its surfaces.

Children trying this activity can

- Make and test a model glider.
- Use information from experiments to design a new glider and evaluate its performance.

Links Activities 72, 75.


C
E
A
B
F
D

Quiz 1

1. There are two kinds of galaxy. What shape are they?
2. What is Io?
3. Who was the first American to walk in space?
4. What does a solar storm produce on Earth?
5. What is the Lagoon Nebula?
6. What is Neptune's moon called?
7. What is the name of the probe that went into Jupiter's atmosphere?
8. Where is the asteroid belt?
9. What happens to a sun close to a black hole?
10. What was the launcher called in the Apollo 11 mission?

Quiz 2

1. What is the connection between the Solar System and the Milky Way?
2. In which Moon mission were footprints first left on the Moon?
3. What are the four largest moons of Jupiter called?
4. What happens to dwarf stars?
5. What may be found on Europa?
6. What is the strange rotating cloud on Jupiter called?
7. Can asteroids have satellites?
8. Where is Meteor Crater?
9. What forms in the Eagle Nebula?
10. Name a rock found on Mars.

Quiz 3

1. Name a volcano found on Venus.
2. What is the Crab Nebula?
3. What are the white patches on Mars called?
4. Name two asteroids that Galileo flew by.
5. What is unusual about the way Uranus spins?
6. What is Pluto's moon called?
7. What are the gas giants?
8. Name an active volcano on Io.
9. Which comet hit Jupiter in 1994?
10. How far is Mars from the Earth?

Quiz 4

1. What is Callisto?
2. What is Charon?
3. What is Europa?
4. Which astronaut travelled in Friendship 7?
5. Who was Yuri Gagarin?
6. What is Ganymede?
7. Where is the Magellanic Cloud?
8. What was Mir?
9. What was the Sputnik?
10. What are sunspots?

Quiz 5

1. Asteroids are sometimes called by another name. What is it?
2. How long does it take asteroids to orbit the Sun?
3. What is the biggest asteroid called?
4. Where is the aurora found?
5. What do electrons in the solar wind do to gases in the atmosphere?
6. How strong is the gravitational pull of the black hole?
7. How may a black hole originally have begun?
8. What is a comet?
9. Which way does a comet's tail point?
10. What is the most famous comet and how often is it visible from Earth?

Quiz 7

1. How large are some craters on the Moon?
2. When did most craters form on the Moon – early or late in its life?
3. Which regions of the Moon have the most craters – the lowlands or the highlands?
4. What caused the Meteor Crater on Earth?
5. Is the Meteor Crater larger than the largest craters on the Moon? Explain your answer.
6. Why is the impact of a meteorite on the Moon more severe than on the Earth?
7. Where do most meteors come from?
8. Where else do a smaller number of meteorites come from?
9. Name two kinds of material from which meteorites may be made.
10. Name a crater found on Venus.

Quiz 6

1. Who are cosmonauts?
2. Who were the first people in space?
3. What was Yuri Gagarin's spacecraft called?
4. How heavy was Yuri Gagarin's spacecraft?
5. How many times did the spacecraft go round the Earth?
6. How many orbits did John Glenn first make?
7. What does the word sputnik mean?
8. How long were the antennae on Sputnik?
9. What kind of satellite was Telstar?
10. Telstar was used to transport TV pictures across part of the Earth – which part?

Quiz 8

1. What do stars release into space?
2. What does a star form from?
3. What is the process which releases large amounts of energy in a star?
4. During this process hydrogen changes into another gas. What is it?
5. What is the nearest star to the Sun?
6. What is the nearest large galaxy to our Milky Way Galaxy?
7. What kind of star is the Sun?
8. How hot is it at the centre of the Sun?
9. What is the middle of a sunspot called?
10. What causes a sunspot on the Sun's surface?

Quiz 9

1. What is star dust?
2. What is Moon dust and how is it made?
3. When does a crescent Moon occur?
4. What is a gibbous Moon and when does it occur?
5. What is an LRV?
6. How many LRVs were used on the Moon?
7. What was the longest journey made by an LRV?
8. What was the purpose of the Voyager probes?
9. Where are the Voyager probes now?
10. What is the name of the latest space station to be built in space?

Answers to Quizzes

Quiz 1

1. Elliptical and spiral.
2. Moon of Jupiter.
3. Ed White.
4. An aurora.
5. An area of hydrogen gas 4,000 light years away.
6. Triton.
7. Galileo.
8. Between the orbits of Mars and Jupiter.
9. Material is spun off it into the black hole.
10. Saturn V.

Quiz 2

1. The Solar System lies in it.
2. Apollo 11.
3. Io, Ganymede, Callisto, Europa.
4. Expand to red giants and explode as supernova.
5. Ocean under an icy surface.
6. Great Red Spot.
7. Yes. Ida has Dactyl.
8. Arizona, USA.
9. Stars.
10. Adirondack.

Quiz 3

1. Gula Mons.
2. Remains of a violently exploding star.
3. Ice caps.
4. Ida, Gaspra.
5. It spins on its side.
6. Charon.
7. Neptune, Uranus, Jupiter and Saturn.
8. Tvashtar Catena.
9. Shoemaker-Levy.
10. 150 million kilometres.

Quiz 4

1. A moon of Jupiter.
2. Pluto's moon.
3. A moon of Jupiter.
4. John Glenn.
5. The first man to orbit the globe.
6. A moon of Jupiter.
7. Just outside the Solar System.
8. A Russian space station.
9. The world's first satellite.
10. Cooler places on the Sun's surface.

Quiz 5

1. Minor planets.
2. Three to six years.
3. Ceres.
4. High in the atmosphere.
5. Make them glow.
6. So strong that nothing can escape from it.
7. After the collapse of a giant star. Its mass growing as it captured other stars.
8. A dirty snowball.
9. Always away from the Sun.
10. Halley's comet. Every 76 years.

Quiz 6

1. People from Russia who go into space.
2. The Russians.
3. Vostok.
4. Five tonnes.
5. Once.
6. Three.
7. Satellite.
8. Three metres.
9. A communications satellite.
10. Atlantic Ocean.

Quiz 7

1. 300 kilometres across.
2. Early in the Moon's life.
3. Highlands.
4. A 50 metre wide iron and nickel meteorite travelling at about 60,000 kilometres an hour.
5. No, it is only 1.5 kilometres across.
6. The Moon has no atmosphere to slow them down or burn them up.
7. The asteroid belt.
8. The Moon and Mars.
9. Stone or rock, the metals iron and nickel.
10. Cunitz.

Quiz 8

1. Gas and X-rays.
2. A nebula.
3. Fusion.
4. Helium.
5. Proxima Centauri, 4.3 light years away.
6. Andromeda Galaxy.
7. A dwarf yellow star.
8. 15 million degrees.
9. Umbra.
10. A magnetic field travelling through the Sun's surface.

Quiz 9

1. Tiny particles of rock made when meteorites struck the surface and shattered.
2. Small particles in space made from glass, carbon and silicate mineral grains.
3. Between a new Moon and a half Moon.
4. The Moon when more than a half of its surface is lit up. Between a half and a full Moon.
5. Lunar roving vehicle.
6. Three.
7. 20.1 km.
8. To gather information about the planets.
9. Edge of the Solar System.
10. International Space Station.

Topic index

The activities in this manual are numbered from 1 to 80 and are listed by title on the contents page. They are broadly categorised under ‘Spaceship Earth’, ‘Solar System and beyond’ and ‘Journey into space’. If you are looking for an activity on a particular topic within these categories, try looking here *(please note that this topic index is referenced to PAGE numbers in this manual and NOT activity numbers):*

