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FREE EBOOK

SCIENCE PROJECTS AND KITS

Earth, Space and Geography Models

Solar system, seasons, eclipses, volcanoes and the water cycle explained

INSIDE THIS BOOK

- The solar system and the problem of scale
- Day, night and the year
- Why we have seasons
- Phases of the Moon
- Solar and lunar eclipses
- ...and 6 more chapters, practice questions and a glossary

Beginner

Students of class 3 to 10

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Earth, Space and Geography Models

Clear explanations and step-by-step model ideas for the solar system, day and night, seasons, phases of the Moon, eclipses, the layers of the Earth, volcanoes, earthquakes, weather, maps and rainwater harvesting. You will be able to build each model, explain the science behind it and answer the questions judges usually ask.

WHO IT IS FOR	Students of class 3 to 10
LEVEL	Beginner
SUBJECT AREA	Science projects and kits
WHAT IS INSIDE	11 chapters, practice questions with answers, and a glossary

HOW TO USE IT

Read one chapter at a time and try the examples as you go: on a computer, at your workbench or in your notebook. The boxes give tips, safety points and short activities. When you finish, test yourself with the practice questions and check your answers at the end. Words you may not know are explained in the glossary.



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The solar system and the problem of scale

The solar system is the Sun and everything that travels around it. That includes eight planets, dwarf planets such as Pluto, moons, millions of rocky asteroids and icy comets. The Sun is a star: a huge ball of very hot gas that makes its own light and heat.

The eight planets

The planets, in order from the Sun, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. The first four are small and rocky. The last four are giants made mostly of gas, or of gas and ice.

Planet	Type	A fact worth remembering
Mercury	Rocky	Smallest planet and closest to the Sun; its year is only 88 Earth days
Venus	Rocky	Hottest planet, because its thick carbon dioxide air traps heat
Earth	Rocky	The only planet known to have life and liquid water on its surface
Mars	Rocky	Looks red because its dust contains iron oxide, the same substance as rust
Jupiter	Gas giant	Largest planet; its Great Red Spot is a giant storm
Saturn	Gas giant	Has bright, wide rings made of pieces of ice and rock
Uranus	Ice giant	Spins tipped over on its side
Neptune	Ice giant	Farthest planet from the Sun, with very strong winds

DID YOU KNOW

Pluto was called a planet until 2006. That year, astronomers agreed on a new definition of a planet, and Pluto became a "dwarf planet". It has not changed. Only its label did.

Why a "to scale" model is tricky

"To scale" means every part is made smaller by the same amount. The problem is that the planets are tiny compared with the gaps between them. If you shrink the Sun to a ball 14 cm wide, the Earth becomes a grain 1.3 mm wide, about 15 metres away. Neptune would be a speck half a millimetre wide, about 450 metres away. That will not fit on any table.

So most models use **two scales**: one for sizes and one for distances. Always tell the judges this.

A size model (1 cm = 5,000 km)

Planet	Real width (km)	Model width (cm)
Mercury	4,879	1.0
Venus	12,104	2.4
Earth	12,756	2.6
Mars	6,792	1.4
Jupiter	142,984	28.6
Saturn	120,536	24.1
Uranus	51,118	10.2
Neptune	49,528	9.9

On this scale the Sun would be about 2.8 metres wide. Show it as a large curved yellow edge along one side of your board.

A distance model (1 metre = 50 million km)

Mercury 1.2 m, Venus 2.2 m, Earth 3.0 m, Mars 4.6 m, Jupiter 15.6 m, Saturn 28.6 m, Uranus 57.3 m and Neptune 90.3 m from the Sun.

TRY THIS

Take a measuring tape to the school ground. Place a friend holding a "Sun" sign at one end. Walk out the distances above and put a labelled stick at each planet. The huge empty space after Mars surprises everyone.

TIP

Make the planet balls from clay, papier-mâché or recycled paper balls, not thermocol. Push each onto a toothpick so it stands upright on the board.

CHAPTER 2

Day, night and the year

The Earth moves in two ways at the same time. It spins, and it travels around the Sun.

Rotation: the spin that makes day and night

Rotation means spinning on an axis. The axis is an imaginary line through the North Pole and the South Pole. The Earth turns once in about 24 hours, from west to east.

At any moment, the half of the Earth facing the Sun has day. The other half has night. As the Earth turns, places move from night into day (sunrise) and from day into night (sunset). The Sun seems to rise in the east because we are turning towards the east.

Revolution: the journey that makes a year

Revolution means moving around something. The Earth goes once around the Sun in about 365¼ days. We use 365 days in a normal year. The extra quarter day adds up to about one whole day every four years, so most years that divide exactly by four get a 29 February. These are leap years.

DID YOU KNOW

Century years such as 1900 and 2100 are not leap years unless they divide exactly by 400. That is why 2000 was a leap year but 1900 was not. This small rule keeps the calendar in step with the seasons.

Model: day and night with a globe and torch

1. Darken the room. Put a torch on a pile of books so it shines level at the globe. The torch is the Sun.
2. Stick a tiny paper figure on India.
3. Turn the globe slowly from west to east. Seen from above the North Pole, this is anticlockwise.
4. Watch the figure move from the dark side into the light (sunrise), across the bright side (noon) and back into darkness (sunset).

EXAMPLE

India is wide from east to west. When Riya in Itanagar, Arunachal Pradesh, sees the sunrise, it is still dark for her cousin Dev in Dwarka, Gujarat. The Sun rises there about an hour and a half later. All of India still uses one clock time, Indian Standard Time.

REMEMBER

Rotation (spinning) gives day and night. Revolution (going around the Sun) gives the year.

Why we do not feel the spin

The Earth turns very smoothly and at a steady speed. We, the air and everything around us move along with it. You feel movement only when speed changes, like when a bus suddenly brakes.

Why we have seasons

Many people think summer comes when the Earth is closer to the Sun. That is wrong. The real reason is the **tilt** of the Earth's axis.

The tilt

The Earth's axis is tilted by about 23.5 degrees. As the Earth goes around the Sun, the axis keeps pointing in the same direction in space, roughly towards the Pole Star. So for part of the year the northern half of the Earth leans towards the Sun, and for part of the year it leans away.

- **Around June:** The northern half leans towards the Sun. The Sun climbs high in the sky at noon, its rays fall more directly, and days are longer. It is summer in India.
- **Around December:** The northern half leans away. The Sun stays lower, its rays are slanting, and days are shorter. It is winter in India.
- **Around March and September:** Neither half leans towards the Sun. Day and night are nearly equal everywhere. These are the equinoxes.

DID YOU KNOW

The Earth is actually closest to the Sun in early January, during India's winter. This one fact proves that distance does not cause our seasons.

Why slanting light heats less

TRY THIS

Shine a torch straight down on squared paper and count the lit squares. Now tilt the torch so the light falls at a slant. The same light now spreads over more squares, so each square gets less. Slanting sunlight works the same way, so it warms the ground less.

Model: the seasons

1. Put a battery lamp (a 6 V LED lamp is ideal) in the middle of a table as the Sun.

2. Push a small ball onto a knitting needle or thin stick, tilted at about 23.5 degrees from upright. Use a protractor to set it.
3. Put up a sign on one wall saying "This way to the Pole Star". Keep the top of the needle leaning towards that wall the whole time.
4. Place the ball at four positions around the lamp: June, September, December and March.
5. At each position, see whether the northern half or southern half gets more direct light.

REMEMBER

When it is summer in India, it is winter in Australia. The two halves of the Earth always have opposite seasons.

Special lines and days

Around 21 June, the noon Sun is directly overhead at the Tropic of Cancer, which passes through eight Indian states, from Gujarat in the west to Mizoram in the east. Around 22 December, it is overhead at the Tropic of Capricorn, far to the south. In India, the monsoon winds also shape the seasons, which is why we speak of a rainy season as well as summer and winter.

CHAPTER 4

Phases of the Moon

The Moon does not make its own light. It shines because sunlight falls on it and bounces off. At every moment, one half of the Moon is lit by the Sun. The phases are how much of that lit half we can see from Earth.

The cycle

From one full moon to the next takes about 29.5 days. During the first half, the lit part we see grows (waxing). During the second half, it shrinks (waning). In Hindi, these halves are called shukla paksha and krishna paksha.

Phase	What we see	Common name
New moon	Almost nothing; the lit side faces away	Amavasya
Waxing crescent	A thin curved sliver on the right (seen from India)	
First quarter	Right half lit	
Waxing gibbous	More than half lit	
Full moon	The whole round face lit	Purnima
Waning gibbous	More than half, shrinking	
Last quarter	Left half lit	
Waning crescent	A thin sliver on the left, seen before dawn	

REMEMBER

The Earth's shadow does NOT cause the phases. That is a common mistake. The Earth's shadow falls on the Moon only during a lunar eclipse.

Model: your head is the Earth

1. Push a white ball onto a pencil. This is the Moon.
2. Put a bright lamp at one end of a dark room. This is the Sun.
3. Stand facing the lamp and hold the ball at arm's length, a little above your head.
4. Turn slowly on the spot, anticlockwise, keeping the ball in front of your face.
5. Watch the lit part of the ball change: new, crescent, quarter, gibbous, full and back again.

Model for an exhibition board

Draw the Earth in the centre of a round board and the Sun's rays coming from one side. Place eight half-white, half-black balls in a circle around the Earth, with the white half always facing the Sun. Beside each ball, draw how that Moon looks from the Earth.

DID YOU KNOW

The Moon always shows us the same face. It turns once on its axis in the same time it takes to go once around the Earth. The far side is not always dark, though. It gets sunlight during our new moon.

TRY THIS

Keep a Moon diary for a month. Each evening, at the same time, draw the Moon's shape and note its position in the sky. Bring the diary to the exhibition as evidence.

CHAPTER 5

Solar and lunar eclipses

An eclipse happens when the Sun, the Earth and the Moon line up exactly, and one of them blocks light from reaching another.

Solar eclipse

In a solar eclipse, the Moon passes between the Sun and the Earth, and its shadow falls on part of the Earth. It can only happen at new moon (amavasya).

- **Total:** The Moon covers the Sun completely. The sky goes dark for a few minutes.
- **Partial:** The Moon covers only part of the Sun.
- **Annular:** The Moon is a little farther from the Earth than usual, so it looks slightly smaller and leaves a bright ring of the Sun showing.

Lunar eclipse

In a lunar eclipse, the Earth passes between the Sun and the Moon, and the Earth's shadow falls on the Moon. It can only happen at full moon (purnima). During a total lunar eclipse the Moon often turns a coppery red. This is because the Earth's air bends a little sunlight into the shadow, and mostly red light gets through.

Why not every month?

The Moon's path around the Earth is tilted by about 5 degrees compared with the Earth's path around the Sun. So at most new and full moons, the Moon passes a little above or below the line joining the Sun and the Earth, and no eclipse happens.

Shadows have two parts

- **Umbra:** the dark centre of a shadow, where all the light is blocked.
- **Penumbra:** the lighter outer part, where only some light is blocked.

People in the Moon's umbra see a total solar eclipse. People in the penumbra see a partial one.

DID YOU KNOW

The Sun is about 400 times wider than the Moon, and also about 400 times farther away. That is why they look almost the same size in our sky, and why the Moon can just cover the Sun.

Model: eclipses with a torch and two balls

1. Fix a torch at one end of a table. It is the Sun.
2. Put a big ball (Earth) and a small ball (Moon) on sticks in a line with the torch.
3. Moon between torch and Earth: see the small shadow fall on the Earth (solar eclipse).
4. Earth between torch and Moon: see the Moon go into the Earth's shadow (lunar eclipse).
5. Now raise the Moon a little. The shadows miss. This shows the 5-degree tilt.

SAFETY

Never look at the Sun directly, during an eclipse or at any other time. Sunglasses, smoked glass, X-ray film and binoculars are NOT safe. Use proper certified solar eclipse glasses, or watch an image of the Sun made by a pinhole in a card. A lunar eclipse is completely safe to watch with your eyes.

Inside the Earth and a volcano model

We cannot dig to the centre of the Earth. The deepest hole ever drilled goes down a little over 12 km, which is less than one five-hundredth of the way to the centre. Scientists learnt about the inside by studying how earthquake waves travel through it, bend and change speed.

The four layers

Layer	Depth below surface	What it is like
Crust	0 to about 5–70 km	Solid rock; thin under oceans, thicker under continents
Mantle	To about 2,900 km	Very hot rock that moves very slowly, like extremely thick toffee
Outer core	About 2,900 to 5,150 km	Liquid metal, mostly iron and nickel
Inner core	About 5,150 to 6,371 km (the centre)	Solid metal, thought to be about as hot as the surface of the Sun

Model: a cut-away Earth (1 cm = 500 km)

On this scale the Earth's radius is 12.7 cm, so the whole Earth would be a ball about 25 cm wide. A solid clay ball that size would be far too heavy, so make a half-Earth instead.

1. Cover a round bowl about 25 cm wide with papier-mâché to make a dome. Let it dry and lift it off.
2. Cut a circle of stiff card the same size for the flat face.
3. On the card, use a compass to draw the circles in the table below, and paint each ring a different colour.
4. Glue the card to the dome, and paint the dome's outside with oceans and continents.

Layer	Radius on the model	Colour idea
Inner core	Up to 2.4 cm	Yellow
Outer core	Up to 7.0 cm	Orange
Mantle	Up to 12.7 cm	Red-brown
Crust	A line under 1.5 mm thick at the edge	Dark brown

REMEMBER

The crust is thinner, compared with the whole Earth, than the skin of an apple. On your model it is just a thin painted line.

Real volcanoes

A volcano is an opening in the crust where melted rock comes out. Below the ground, melted rock is called magma. When it comes out, it is called lava. A volcano has a magma chamber, a vent (the pipe), and a crater at the top. It can throw out lava, ash and gases.

DID YOU KNOW

India has one active volcano, on Barren Island in the Andaman Sea. The Deccan Plateau's dark rocks, called the Deccan Traps, were formed by enormous lava flows millions of years ago.

Building the volcano model

1. Fix a small plastic bottle in the middle of a strong base board.
2. Build a cone around it with crumpled newspaper and masking tape. Leave the bottle mouth open at the top.
3. Cover the cone with papier-mâché strips or clay. Let it dry fully.
4. Paint it brown and grey, with red-orange streaks of "lava".
5. To erupt: put two spoons of baking soda, a few drops of dish soap and a drop of red food colour into the bottle. Pour in half a cup of vinegar.

Vinegar is an acid and baking soda is a base. When they react, they make carbon dioxide gas. The gas bubbles push the foamy liquid out of the top.

SAFETY

Do the eruption on a tray, with goggles on. Never cap or seal the bottle. Use only baking soda and vinegar, never other chemicals from home. Wipe up spills quickly.

CHAPTER 7

Earthquakes and a seismograph model

An earthquake is a sudden shaking of the ground. It happens when huge pieces of rock deep underground suddenly slip past each other.

Plates and faults

The Earth's crust is broken into giant pieces called plates. They move very slowly, a few centimetres a year, about as fast as your fingernails grow. Where plates push, pull or slide past each other, stress builds up in the rocks. When the rock suddenly breaks and slips, energy spreads out as waves. A crack where rocks have moved is called a fault.

- **Focus:** the point underground where the slip starts.
- **Epicentre:** the point on the surface directly above the focus. Shaking is usually strongest here.

DID YOU KNOW

The Indian Plate is moving slowly north and pushing into the Eurasian Plate. This collision raised the Himalayas, and it is why the Himalayan region and North-East India have many earthquakes.

Measuring earthquakes

A seismometer is an instrument that detects ground shaking. The record it makes is a seismogram. The size of an earthquake is given as a magnitude. Each step up by one whole number means roughly ten times bigger waves on the record and about 32 times more energy.

Model: a simple seismograph

1. Make a frame from a strong cardboard box with one side cut open.
2. Push a felt pen through the bottom of a paper cup, tip pointing down, and fill the cup with sand to make it heavy.
3. Hang the cup from the top of the box with string, so the pen tip just touches the floor of the box.
4. Slide a long strip of paper slowly under the pen.
5. Ask a friend to tap or shake the table. The heavy cup tends to stay still while the box moves, so the pen draws zigzags.

Gentle shaking gives small zigzags. Strong shaking gives big ones. This is exactly the idea behind real seismographs.

TRY THIS

Build a shake table from a tray resting on four marbles inside a larger box. Make two buildings from straws and clay, one with diagonal braces and one without. Shake the tray and see which stays standing longer.

Staying safe

SAFETY

During an earthquake: **Drop** to the ground, take **Cover** under a strong table, and **Hold On** until the shaking stops. Stay away from glass, windows and heavy shelves. Do not use lifts. If you are outside, move to an open space away from buildings, trees and wires.

CHAPTER 8

The water cycle, a rain gauge and rainwater harvesting

The water on Earth keeps moving between the sea, the air and the land. This never-ending journey is the water cycle. About 97 per cent of the Earth's water is salty ocean water.

Four main steps

- 1. Evaporation:** The Sun heats water in seas, rivers and lakes. It turns into invisible water vapour and rises.
- 2. Condensation:** High up, the air is cooler. The vapour cools into tiny droplets that form clouds.
- 3. Precipitation:** Droplets join and grow heavy, then fall as rain, or as hail or snow in very cold places.
- 4. Collection:** Rain flows into rivers, lakes and the sea, or soaks into the ground as groundwater.

Plants also give out water vapour from their leaves. This is called transpiration.

TRY THIS

Put warm water in a bowl. Cover it with cling film and place ice cubes on top. In a few minutes, droplets form under the film and drip back. You have made a tiny water cycle.

Model: a rain gauge

Rainfall is measured as the depth of water, in millimetres, that would cover flat ground if none of it soaked in or flowed away.

- 1.** Take a straight-sided plastic bottle. Ask an adult to cut off the top third.
- 2.** Put some pebbles in the bottom, then add water until it covers them. Mark this level as zero, because the bottom of a bottle is not flat.
- 3.** Stick a paper ruler on the side, starting at zero, in millimetres.
- 4.** Turn the cut top upside down and fit it into the bottle as a funnel. It is the same width as the bottle, so the depth you read is the rainfall.
- 5.** Place it in an open space, away from trees and roofs. Read it at the same time every day, record it, then pour out water down to the zero mark.

DID YOU KNOW

Mawsynram and Sohra (Cherrapunji) in Meghalaya are among the wettest places on Earth, while parts of western Rajasthan get very little rain.

Rainwater harvesting

Rainwater harvesting means collecting rain instead of letting it run off. Rain from a roof flows through pipes into a filter of gravel, sand and charcoal, and then into a storage tank or a recharge pit that lets it soak into the ground. A first-flush pipe throws away the first, dirty rain from the roof.

EXAMPLE

1 mm of rain on 1 square metre gives 1 litre of water. Aarav's house in Jaipur has a roof of 100 square metres. If his town gets 600 mm of rain in a year and his family collects 80% of it, they save $100 \times 600 \times 0.8 = 48,000$ litres. At a tanker price of, say, ₹ 500 for 5,000 litres, that is ₹ 4,800 of water.

For the model, build a small house with a sloping roof, straw gutters, a transparent bottle filter with layers you can see, and a tank. Pour water on the roof with a jug to show it working.

CHAPTER 9

Wind and air pressure

Air may be invisible, but it has weight and it presses on everything. This push is called air pressure. At sea level, air presses on every square centimetre with roughly the weight of 1 kg. We do not get crushed because the air inside our bodies pushes back equally.

Why wind blows

Wind is moving air. It blows from places of high pressure to places of low pressure.

When the Sun heats the ground, the air above it warms up, becomes lighter and rises. This leaves lower pressure near the ground. Cooler, heavier air flows in to take its place. That flow is wind.

- **Sea breeze:** By day, land heats up faster than the sea. Air over the land rises, and cool air blows in from the sea.

- **Land breeze:** At night, land cools faster. The flow reverses and the breeze blows from land to sea.
- **Monsoon:** In summer, the Indian land heats up much more than the ocean around it. Moist winds from the sea blow in and bring the monsoon rains. Other factors are involved too, but this heating is a big part of the story.

REMEMBER

Air flows from high pressure to low pressure, just as water flows downhill.

Model: a cup anemometer

An anemometer measures wind speed.

1. Fix four paper cups to the ends of two crossed straws or thin sticks, all cups facing the same way round.
2. Push a pin through the centre into the eraser of a pencil, so the cross spins freely.
3. Colour one cup so you can count turns.
4. Hold it in the wind and count turns in one minute. More turns mean stronger wind.

Model: a wind vane

Cut an arrow from card with a large tail. Pin it to a stick so it turns freely. Mark N, E, S and W on the base using a compass. The arrow points to the direction the wind is coming **from**, and winds are named that way. A "west wind" blows from the west.

Model: a jar barometer

1. Stretch a piece of balloon tightly over the mouth of a glass jar and seal it with a rubber band.
2. Tape one end of a straw to the centre of the balloon, so the straw rests on the rim of the jar and sticks out beyond it.
3. Stand a card beside the jar and mark where the free end of the straw points each day.
4. When outside air pressure rises, it pushes the balloon down and the straw end rises.

TIP

Keep the jar barometer out of the sunlight and away from a fan. Warming the air in the jar also moves the straw, which would spoil your readings.

DID YOU KNOW

Air pressure falls as you go higher. That is why your ears feel strange in an aeroplane or on a hill road to Shimla.

CHAPTER 10

Globes, latitude, longitude and a contour model

Latitude and longitude

To find any place on Earth, we use a grid of imaginary lines.

- **Latitude** lines run east to west, parallel to the equator. The equator is 0° . The North Pole is 90° N and the South Pole is 90° S.
- **Longitude** lines run from pole to pole. The line at 0° is the Prime Meridian, which passes through Greenwich in London. Longitude goes up to 180° east and 180° west.

A place is written as latitude, then longitude. Delhi is at about 28.6° N, 77.2° E.

DID YOU KNOW

The Earth turns 360 degrees in 24 hours, which is 15 degrees every hour, or 1 degree every 4 minutes. Indian Standard Time is set by the 82.5° E line of longitude, which passes near Mirzapur in Uttar Pradesh.

Model: a latitude and longitude globe

1. Take a ball or a round balloon covered with papier-mâché.
2. Put a rubber band around the middle for the equator.

3. Add bands above and below for 30° and 60° north and south. They get smaller towards the poles.
4. Add bands through both poles for longitudes, spaced evenly.
5. Mark the Prime Meridian in a different colour and stick a flag on India.

Contour lines

A contour line joins points that are at the same height above sea level. Maps use them to show hills and valleys on flat paper.

- Lines close together mean a **steep** slope.
- Lines far apart mean a **gentle** slope.
- The height difference between two neighbouring lines is the contour interval.

Model: a clay hill and its contour map

1. Make a clay hill about 10 cm tall inside a clear plastic box. Make one side steep and one side gentle.
2. Mark the outside of the box every 2 cm in height.
3. Pour in water up to the first mark.
4. Look straight down through a clear sheet placed on top of the box, and trace the waterline with a marker.
5. Add water to the next mark and trace again. Repeat to the top.

The drawing you get is a contour map of your hill. Notice how the lines bunch together on the steep side.

EXAMPLE

Meera in Dehradun made her hill with a sharp cliff on one side. On her contour drawing, the lines on that side almost touched. The judges asked her why, and she could explain it at once.

TIP

Cardboard works too. Cut five or six cardboard layers, each a smaller outline than the one below, and stack them. Each cardboard edge is a contour line.

Presenting your model and answering questions

A good model can lose marks if you cannot explain it. A simple model, clearly explained, often beats a fancy one.

The board

- Give the model a clear title that can be read from two metres away.
- Label every part with a neat printed or hand-lettered tag.
- Add a small "How it works" chart with three to five short points.
- Write the scale you used, for example "Sizes: 1 cm = 5,000 km. Distances: not to scale."

Your two-minute talk

1. Say what the model shows in one sentence.
2. Explain the science in three or four simple steps.
3. Demonstrate the working part, if there is one.
4. End with one real-life link, such as earthquake safety or saving rainwater.

TIP

Practise your talk in front of family. Ask them to stop you whenever a word is unclear, and then use a simpler one.

Questions judges often ask

Question	Short answer
Why do we have seasons?	The Earth's axis is tilted, so each half gets more direct sunlight for part of the year.
Why is there no eclipse every month?	The Moon's path is tilted by about 5 degrees, so it usually passes above or below the Sun–Earth line.

Question	Short answer
Why does the Moon change shape?	We see different amounts of its sunlit half as it goes around the Earth.
Is your solar system model to scale?	Sizes and distances use different scales, because a single scale would not fit.
What makes your volcano erupt?	Baking soda and vinegar react to make carbon dioxide gas, which pushes the foam out.
How does a rain gauge measure rain?	It collects rain and shows its depth in millimetres.

REMEMBER

If you do not know an answer, say "I am not sure, but I will find out." Honesty impresses judges far more than guessing.

SAFETY

On exhibition day, keep vinegar and baking soda in sealed containers, keep a cloth for spills, and switch off battery lamps when you are not demonstrating them.

CHECK YOURSELF

Practice questions

1. Name the four rocky planets in order from the Sun.
2. Why do most solar system models use two different scales?
3. On a scale of 1 cm = 5,000 km, how wide is a model of Earth?
4. What is the difference between rotation and revolution?
5. Why does the Sun seem to rise in the east?
6. Why was 2000 a leap year but 1900 was not?
7. What causes the seasons?

8. Give one fact that shows distance from the Sun does not cause seasons.
9. Why does slanting sunlight warm the ground less than direct sunlight?
10. How long does the Moon take to go from one full moon to the next?
11. What causes the phases of the Moon?
12. On which phase of the Moon can a solar eclipse happen?
13. Why does the Moon look red during a total lunar eclipse?
14. Name two ways of watching a solar eclipse safely.
15. Name the four layers of the Earth from outside to inside.
16. Which gas makes the model volcano erupt?
17. What is the epicentre of an earthquake?
18. What should you do during an earthquake?
19. Name the four main steps of the water cycle.
20. A roof of 50 square metres gets 10 mm of rain. How many litres fall on it?
21. Why does a sea breeze blow during the day?
22. Which way does a wind vane's arrow point?
23. What do contour lines close together tell you?

ANSWER KEY

Answers

1. Mercury, Venus, Earth and Mars.
2. The planets are tiny compared with the distances between them, so one scale would make the planets too small to see or the model far too big.
3. Earth is about 12,756 km wide, so the model is about 2.6 cm wide.
4. Rotation is the Earth spinning on its axis, which gives day and night. Revolution is the Earth going around the Sun, which gives the year.
5. The Earth turns from west to east, so places turn towards the Sun on the eastern side.

6. Century years are leap years only if they divide exactly by 400. 2000 does, but 1900 does not.
7. The tilt of the Earth's axis, which makes each half of the Earth lean towards the Sun for part of the year.
8. The Earth is closest to the Sun in early January, which is winter in India.
9. Slanting light spreads the same energy over a bigger area, so each part of the ground gets less.
10. About 29.5 days.
11. As the Moon goes around the Earth, we see different amounts of the half of it lit by the Sun.
12. Only at new moon (amavasya), when the Moon is between the Sun and the Earth.
13. The Earth's air bends some sunlight into its shadow, and mainly red light gets through to the Moon.
14. Certified solar eclipse glasses, or an image of the Sun made through a pinhole in a card.
15. Crust, mantle, outer core and inner core.
16. Carbon dioxide, made when baking soda reacts with vinegar.
17. The point on the Earth's surface directly above the place where the earthquake starts underground.
18. Drop to the ground, take cover under a strong table and hold on until the shaking stops, keeping away from glass and heavy objects.
19. Evaporation, condensation, precipitation and collection.
20. $50 \times 10 = 500$ litres, because 1 mm on 1 square metre is 1 litre.
21. Land heats faster than the sea, so warm air rises over the land and cooler air from the sea blows in.
22. It points towards the direction the wind is coming from.
23. The slope is steep there.

WORD LIST

Glossary

Solar system

the Sun and all the planets, moons, asteroids and comets that travel around it.

Planet

a large round body that travels around the Sun and has cleared its path of other objects.

Dwarf planet

a round body that travels around the Sun but has not cleared its path, such as Pluto.

Scale

the amount by which every part of a model is made smaller than the real thing.

Axis

an imaginary line through the North and South Poles that the Earth spins around.

Rotation

the Earth spinning on its axis, which causes day and night.

Revolution

the Earth's journey around the Sun, which takes about a year.

Equinox

a day around March or September when day and night are nearly equal everywhere.

Phase

the shape of the lit part of the Moon that we see from Earth.

Eclipse

the blocking of light when the Sun, Earth and Moon line up exactly.

Umbra

the dark centre of a shadow, where all light is blocked.

Penumbra

the lighter outer part of a shadow, where only some light is blocked.

Crust

the thin, solid, rocky outer layer of the Earth.

Mantle

the thick layer of hot, slowly moving rock below the crust.

Magma

melted rock below the Earth's surface; it is called lava once it comes out.

Plate

one of the giant pieces that the Earth's crust is broken into.

Epicentre

the point on the surface directly above where an earthquake starts.

Seismometer

an instrument that detects and records ground shaking.

Evaporation

water turning into water vapour.

Condensation

water vapour cooling and turning into liquid droplets.

Air pressure

the push of the air on everything around it.

Latitude

imaginary lines running east to west, measuring distance north or south of the equator.

Longitude

imaginary lines running from pole to pole, measuring distance east or west of the Prime Meridian.

Contour line

a line on a map joining places at the same height above sea level.



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