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FREE EBOOK

SCIENCE PROJECTS AND KITS

Science Projects for Class 6 to 8

Working models matched to middle-school science topics

INSIDE THIS BOOK

- Choosing a project by chapter
- Electricity and magnetism
- Light
- Water
- Sun, wind and weather
- ...and 5 more chapters, practice questions and a glossary

Beginner

Students of class 6 to 8 and their teachers

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Science Projects for Class 6 to 8

Eighteen projects for class 6 to 8, matched to the topics in your science book: circuits, magnets, light, water, weather, acids and bases, the human body, friction, sound and plants. Each project gives materials, safe numbered steps, the science explained simply, and viva questions with answers, followed by tips for presenting your work with confidence.

WHO IT IS FOR	Students of class 6 to 8 and their teachers
LEVEL	Beginner
SUBJECT AREA	Science projects and kits
WHAT IS INSIDE	10 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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What you will find inside

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Choosing a project by chapter

The best project grows out of a topic you are studying: it is easier to understand, and the viva questions feel familiar.

Match the project to your topic

Chapter names and their order change between books, boards and editions, so match by topic, not by chapter number.

Topic in your science book	Projects in this book
Electricity and circuits	1. Circuit board quiz
Magnets and the magnetic effect of current	2. Electromagnet crane, 3. Simple generator
Light, shadows and reflection	4. Periscope, 5. Pinhole camera, 6. Reflection with mirrors
Water and how to save it	7. Water filter, 8. Rainwater harvesting
Heat and energy from the sun	9. Solar cooker
Weather, wind and air	10. Wind vane and anemometer
Acids, bases and salts	11. Acid-base indicators
Physical changes, separating substances	12. Crystallisation
Breathing and respiration	13. Lungs model
Blood and the heart	14. Heart model
Food and digestion	15. Digestive system model
Force, friction and motion	16. Friction ramp
Sound	17. Sound and vibration
Plants and their needs	18. Plant growth experiment

Three questions before you start

1. **Do I understand the science?** Read that chapter of your book first.
2. **Can I finish it in time?** Projects 12 and 18 need one to two weeks to show results.
3. **What kind of project is it?** A working model does something, a still model shows how something is arranged, and an investigatory project answers a question with a fair test.

How each project is set out

Every project lists what you need, gives steps, explains the science, and ends with viva questions. A **viva** is a short spoken test in which a teacher or judge asks about your project.

SAFETY

Use only cells and batteries, never more than 9 V, and never connect anything to a wall socket. An adult must do all cutting with a cutter or hacksaw, handle glass and mirrors with sharp edges, and help with anything hot.

TIP

Keep a project notebook from day one: the date, what you did, what went wrong and your readings. It becomes your project file almost by itself.

CHAPTER 2

Electricity and magnetism

Project 1: Electric circuit board quiz

You need: a sheet of thick cardboard (about 30 cm × 40 cm), ten brass paper fasteners (split pins), insulated wire, two AA cells in a holder, a red LED with a 100 Ω resistor (or a small buzzer), two long wires to use as probes, paper and sketch pens.

Steps:

1. Write five questions down the left side of the board and their five answers down the right side, in a mixed-up order.

2. Push a paper fastener through the board beside each question and each answer.
3. On the back, join each question's fastener to the fastener of its correct answer with a wire. Wrap the bare ends tightly round the fastener legs.
4. Cover the back with paper, making sure no bare wires touch each other.
5. Make the tester: cell holder, resistor, LED and the two probe wires in one line.
6. Touch one probe to a question and the other to an answer. The LED glows only for the correct answer.

The science: The LED glows only in a **closed circuit**. The hidden wire joins each question to its right answer, so only that pair completes the path. A wrong pair leaves a gap, an **open circuit**.

Viva questions: Why is there a resistor with the LED? It limits the current so the LED does not burn out. What happens if two bare wires touch at the back? Current can take a wrong path, so a wrong answer may light up.

Project 2: Electromagnet crane

You need: ice-cream sticks or thick card for the tower and arm, a thread spool and a pencil for the winch, string, a large iron bolt, about 3 m of insulated or enamelled copper wire, two AA cells in a holder, a push switch, glue, and paper clips or pins as the load.

Steps:

1. Build a tower about 30 cm tall on a heavy base and fix an arm at the top that sticks out to one side.
2. Push a pencil through the spool and fix it to the tower as a winch, with a card handle to turn it.
3. Wind about 100 turns of wire on the bolt, all in the same direction. Sand the ends if the wire is enamelled.
4. Tie the string to the bolt, run it over the end of the arm and wind it onto the spool.
5. Run the coil's wires loosely down to the switch and cells on the base.
6. Lower the bolt onto the pins, press the switch, wind up the winch, swing the arm and release the switch.

The science: A current in a coil makes a magnetic field, and the iron bolt makes it many times stronger. When the current stops, the bolt loses almost all its magnetism and the load drops. Scrapyard cranes use giant electromagnets in the same way.

Viva questions: Why not use an ordinary magnet? It could not let go of the load. Why do a few pins sometimes stay stuck? Some steel keeps a little magnetism after the current stops.

SAFETY

Press the switch for only a few seconds at a time. The coil is nearly a short circuit and the cells get warm.

Project 3: Simple generator

You need: a small toy DC motor, a red LED, string; for part two, about 15 m of thin enamelled copper wire, a narrow card tube about 2 cm across (rolled round a marker pen), a strong magnet that slides inside the tube, and a multimeter.

Steps:

- 1. Part one:** join the LED to the motor's two terminals. Wind string round the motor shaft and pull it sharply. If the LED does not flash, reverse the LED or spin the other way.
- 2. Part two:** wind about 200 turns of the thin wire round the tube. Sand the ends and join them to the multimeter set to its lowest DC voltage range.
- 3.** Push the magnet quickly into the tube and watch the reading. Hold it still. Pull it out quickly.

The science: When a magnetic field through a coil changes, a voltage is produced in the coil. This is **electromagnetic induction**, discovered by Michael Faraday in 1831. Moving the magnet in gives a reading one way, pulling it out gives the other way, and a still magnet gives nothing. Power station generators work on this idea.

Viva questions: Why is there no reading when the magnet is still? The field through the coil is not changing. How could you get a bigger reading? More turns, a stronger magnet or faster movement.

Light

Project 4: Periscope

You need: a long cardboard box about 40 cm long (or two juice cartons joined end to end), two small plane mirrors of the same size, tape, a protractor, a cutter (for an adult).

Steps:

1. An adult cuts a square window near the top of the box on its front face, and another near the bottom on its back face.
2. Fix one mirror inside, opposite the top window, at 45° to the length of the box, facing down.
3. Fix the second mirror opposite the bottom window, also at 45° , facing up, so the two mirrors are parallel.
4. Look into the bottom window while the top window peeps over a wall or table.

The science: Light from an object enters the top window and hits the top mirror, which turns it through 90° , down the tube. The bottom mirror turns it through 90° again, out to your eye. This works because of the **law of reflection**: light leaves a mirror at the same angle at which it strikes it. Submarines use periscopes to see above the water.

Viva questions: Why are the mirrors at 45° ? So each one turns the light through a right angle. Is the image upright? Yes.

SAFETY

Cover mirror edges with tape before you handle them.

Project 5: Pinhole camera

You need: a shoebox or a long tube, black chart paper or black paint, aluminium foil, a needle, butter paper or tracing paper, tape, a dark cloth.

Steps:

1. Line or paint the inside of the box black.

2. Cut a 2 cm square hole in the middle of one end. Cover it with foil and prick a small, neat hole in the centre of the foil with the needle.
3. Cut a large window in the other end and cover it with butter paper. This is the screen.
4. Cover your head and the screen end with the dark cloth.
5. Point the pinhole at a bright scene, such as a sunlit tree or a lit window, and look at the screen.

The science: Light travels in straight lines. Light from the top of the tree passes through the pinhole and carries on to the bottom of the screen, and light from the bottom reaches the top. So the image is upside down, and reversed left to right as well. A bigger hole lets in more light, giving a brighter but blurrier image.

Viva questions: Why is the inside black? To stop light reflecting around inside and spoiling the image. What happens with a bigger hole? The image is brighter but less sharp.

SAFETY

Never point the camera at the sun and look through it.

Project 6: Reflection with two mirrors

You need: two plane mirrors of the same size, tape, a protractor, a sheet of paper, a small coloured object such as an eraser.

Steps:

1. Tape the two mirrors together along one edge, like a book, with the shiny sides facing each other.
2. On the paper, draw lines from one point at 90°, 60°, 45° and 30°.
3. Stand the mirrors on the paper at 90° and put the eraser between them.
4. Count the images. Repeat at each angle.

Angle between mirrors	Images counted	$360 \div \text{angle} - 1$
90°		3
60°		5

Angle between mirrors	Images counted	$360 \div \text{angle} - 1$
45°		7
30°		11

The science: Light bounces between the mirrors several times, making many images. When $360 \div \text{angle}$ is an even whole number, the number of images is $360 \div \text{angle} - 1$. A plane mirror's image is the same size as the object, as far behind the mirror as the object is in front, and swapped left to right. This swap is called **lateral inversion**. A kaleidoscope uses three mirror strips at 60° to each other.

Viva questions: How many images at 60°? Five. Why is AMBULANCE written back to front on the front of the vehicle? So drivers ahead read it correctly in their rear-view mirrors.

CHAPTER 4

Water

Project 7: Water filter

You need: a 2-litre plastic bottle, cotton wool or a clean cloth, fine sand, coarse sand, small pebbles, larger pebbles, a few pieces of charcoal (optional), muddy water, two clear glasses.

Steps:

1. An adult cuts off the bottom of the bottle. Turn it upside down, with the cap removed, and stand its neck in a glass.
2. Wash the sand and pebbles well before you use them.
3. Fill the bottle in layers from the neck up: a cotton plug, crushed charcoal, fine sand, coarse sand, small pebbles, and larger pebbles on top.
4. Keep a glass of the muddy water to compare. Pour the rest slowly onto the top layer.
5. Compare the water that drips out with the muddy water.

The science: This is **filtration**. Each layer traps particles of a different size: big bits stop in the pebbles, smaller ones in the coarse sand, and the finest in the fine sand and cotton. Charcoal can remove some colour and smell. Water treatment plants use sand beds too, along with other steps such as adding chlorine to kill germs.

Viva questions: Why wash the sand first? Otherwise its own dust makes the water muddy. Why are pebbles on top and fine sand lower down? So the big particles are caught first and the fine layers do not clog quickly.

SAFETY

Never drink water from your filter, however clear it looks. Germs and dissolved substances pass through. Drinking water must be boiled or properly purified.

Project 8: Rainwater harvesting model

You need: a board, card for a house with a sloping roof, straws for gutters and pipes, a small bottle of gravel and sand as a filter, a larger bottle as a tank, a clear cup layered with gravel and sand as a recharge pit, a tray of soil as the ground, and a plastic mug with small holes in its bottom for rain.

Steps:

1. Build the house and fix the gutter along the lower edge of the roof.
2. Run a straw downpipe from the gutter into the filter bottle.
3. Lead a pipe from the filter to the storage tank, and an overflow pipe from the tank to the recharge pit set into the ground.
4. Label every part.
5. Fill the mug with water and hold it over the roof as "rain". Watch the water flow into the tank and soak into the ground through the pit.

The science: Rainwater harvesting catches rain where it falls. It can be stored for later use, or sent into a recharge pit so it soaks down and refills the water under the ground, called **groundwater**. Groundwater levels fall when we pump out more than the rain puts back, and when concrete covers the soil so rain cannot soak in. In the past, stepwells in Rajasthan and Gujarat stored water in the same spirit.

EXAMPLE

1 mm of rain on 1 square metre of roof gives 1 litre of water. If a roof of 50 m² gets 800 mm of rain in a year, it collects up to $50 \times 800 = 40,000$ litres, before any losses.

Viva questions: What is a recharge pit? A pit filled with gravel and sand that lets rainwater soak into the ground. Why have a filter? To remove leaves and dust washed off the roof.

CHAPTER 5

Sun, wind and weather

Project 9: Solar cooker

You need: two cardboard boxes, one fitting inside the other with a 3 to 5 cm gap all round, newspaper, black chart paper, a clear acrylic sheet (or glass, handled by an adult) as a lid, a card flap covered with aluminium foil, a stick, a small black-painted steel container with a lid, a thermometer.

Steps:

1. Put the small box inside the big one and fill the gap with crumpled newspaper.
2. Line the inside of the small box with black paper.
3. Fix the foil-covered flap to one top edge of the box, and prop it with the stick so it reflects sunlight into the box.
4. Put water, or some butter or chocolate, in the black container and place it inside. Cover the box with the clear sheet.
5. Face the cooker towards the sun around midday. Record the temperature every 15 minutes, and adjust the reflector as the sun moves.

The science: The black inside absorbs sunlight and turns it into heat. The clear lid lets sunlight in but traps the warm air, which is the **greenhouse effect**. The newspaper is an **insulator** that slows heat loss, and the reflector sends extra sunlight inside. A school model can melt butter and warm water; well-made box cookers can cook rice or dal slowly over a few hours of bright sun.

Viva questions: Why is there a clear lid? To let sunlight in and keep the heat inside. Why does it work better in summer than in winter? The sun is higher and its light is stronger.

SAFETY

The container gets hot. Lift it with a cloth. Do not stare at the bright reflection from the foil.

Project 10: Wind vane and anemometer

You need: two pencils with erasers, two pins, drinking straws, card, four small paper cups, a stapler, a marker, a compass, and two plastic bottles filled with sand as stands.

Steps for the wind vane:

1. Cut a small arrowhead and a much larger tail from card. Fix them in slits at the two ends of a straw.
2. Push a pin through the middle of the straw into a pencil's eraser, so the straw spins freely.
3. Stand the pencil in a sand bottle. Mark N, E, S and W round it, using the compass.
4. Place it outdoors in the open and note where the arrow points.

Steps for the anemometer:

1. Cross two straws and tape them at the centre.
2. Staple a cup to each end, all facing the same way round, like a wheel. Colour one cup.
3. Push a pin through the centre into the other pencil's eraser and stand it in a sand bottle.
4. Count how many times the coloured cup goes round in one minute. Repeat at different times and places.

The science: The large tail catches more wind and is pushed away, so the arrow points into the wind, towards the direction it is coming from. Winds are named after the direction they come from: a westerly wind blows from the west. The anemometer's cups catch the wind and spin; more turns a minute means a stronger wind. Your model compares winds; a real anemometer is marked to give the speed.

Viva questions: What does an anemometer measure? Wind speed. Why is one cup coloured? So you can count the turns.

CHAPTER 6

Acids, bases and crystals

Project 11: Acid-base indicators

You need: turmeric (haldi) powder, blotting paper, a few China rose (gudhal or hibiscus) flowers, blue and red litmus paper from a science shop, small bowls, and kitchen liquids: lemon juice, vinegar, tamarind water, soap solution, baking soda solution, sugar solution and salt water.

Steps:

- 1. Turmeric paper:** mix turmeric with a little water into a paste, spread it on blotting paper, dry it and cut it into strips.
- 2. China rose indicator:** an adult soaks the petals in warm water for a few minutes until the water is coloured, then strains it.
- 3.** Pour each test liquid into a labelled bowl.
- 4.** Dip a turmeric strip, a blue and a red litmus strip in each. Add a few drops of China rose indicator to a second sample of each.
- 5.** Record every colour.

Liquid	Turmeric	China rose	Blue litmus	Red litmus	Acid, base or neutral?
Lemon juice					
Vinegar					
Soap solution					
Baking soda solution					
Sugar solution					
Salt water					

The science: An **indicator** changes colour in an acid or a base. Acids turn blue litmus red, and bases turn red litmus blue. Turmeric stays yellow in acids but turns reddish-brown in bases. China rose indicator turns dark pink in acids and green in bases. Neutral liquids, such as sugar solution, change none of them.

Viva questions: Why does a turmeric stain on a shirt turn red when washed with soap? Soap solution is a base. Name two acids from the kitchen. Lemon juice and vinegar.

SAFETY

Never taste any test liquid. Use only kitchen liquids, never strong acids or drain cleaners, and wash your hands afterwards.

Project 12: Crystallisation

You need: alum (phitkari) from a grocery shop, a glass jar, a spoon, a coffee filter or clean cotton cloth, thread, a pencil, a magnifying glass.

Steps:

1. An adult heats about a cup of water until it is hot but not boiling and pours it into the jar.
2. Crush the alum and stir it in a spoonful at a time until no more will dissolve. This is a **saturated solution**.
3. Filter it into a clean jar to remove any undissolved bits.
4. Cover the jar with paper and leave it undisturbed overnight.
5. Next day, pick the best crystal from the bottom. Tie it on a thread hanging from a pencil laid across a jar of fresh saturated solution, so it does not touch the sides or bottom.
6. Measure the crystal every day for a week.

The science: Hot water dissolves more alum than cold water. As the solution cools, and as water slowly evaporates, the extra alum comes out as solid **crystals** with flat faces and regular shapes. Alum crystals often grow with eight faces, while salt forms tiny cubes. The crystal on the thread is a **seed crystal**: new alum builds up on it. Crystallisation is a physical change, because the alum can be dissolved again, and it is used to get pure solids.

Viva questions: What is a saturated solution? One in which no more substance will dissolve at that temperature. Why must it cool slowly and undisturbed? To grow fewer, larger, well-shaped crystals.

SAFETY

An adult handles the hot water. Do not eat alum or the crystals.

CHAPTER 7

The human body

Project 13: Lungs model

You need: a 1-litre plastic bottle, a Y-shaped plastic connector (or two straws taped into a Y shape), two small balloons, one large balloon, rubber bands, clay to seal, tape.

Steps:

1. An adult cuts off the bottom of the bottle.
2. Fix a small balloon to each arm of the Y with rubber bands.
3. Push the balloons and the Y into the bottle, with the stem of the Y coming out of the neck. Seal the neck round the stem with clay.
4. Tie a knot in the neck of the large balloon and cut off its rounded top half. Stretch the rest over the open bottom of the bottle, with the knot in the centre to pull it by, and tape it on.
5. Pull the sheet down and watch the balloons. Push it up and watch again.

The science: The rubber sheet is the **diaphragm**, a dome-shaped muscle under the lungs. When it moves down, the space inside the chest gets bigger, the air pressure inside falls, and air rushes in through the windpipe to fill the lungs. When it moves up, air is pushed out. The stem is the windpipe, the arms are the tubes to each lung, and the bottle is the chest. In real lungs the ribs move too, and oxygen passes into the blood through millions of tiny air sacs.

Viva questions: Why do the balloons fill when you pull the sheet down? The space inside gets bigger and the pressure falls, so air rushes in.

Project 14: Heart model

You need: red and blue clay, a board, toothpicks and paper labels, a watch with a seconds hand.

Steps:

1. Make a heart about the size of your fist from clay, with four chambers: two small upper chambers and two larger lower ones.
2. Colour the right side blue (blood low in oxygen) and the left side red (blood rich in oxygen). Make the wall of the lower left chamber the thickest.
3. Add short clay tubes for the main blood vessels, and label everything with toothpick flags.
4. **Pulse test:** find the pulse on the inside of your wrist. Count the beats for 15 seconds and multiply by 4. Do it at rest, then after one minute of skipping.

Condition	Beats in 15 s	Beats per minute
Resting		
After one minute of skipping		

The science: The heart is a muscular pump with four chambers: the right and left **atria** at the top and the right and left **ventricles** below. The right side takes blood from the body and pumps it to the lungs to pick up oxygen. The left side takes this oxygen-rich blood and pumps it to the whole body, which is why its wall is thickest. **Valves** are flaps that let blood flow only one way. A resting adult's heart usually beats about 60 to 100 times a minute, and children's hearts beat a little faster.

Viva questions: What do valves do? Stop blood flowing backwards. Why does your pulse rise after exercise? Your muscles need more oxygen, so the heart pumps faster.

TIP

On a heart drawn from the front, the heart's left side appears on your right. Label carefully, because examiners love this question.

Project 15: Digestive system model

You need: a board with a body outline, a thin rubber tube for the food pipe, a small balloon or clay for the stomach, a long piece of thick wool or thin pipe for the small intestine, a thicker tube for the large intestine, clay in three colours, labels.

Steps:

1. Fix the food pipe from the mouth down to the stomach.
2. Fix the stomach on the left side, under the lower ribs.
3. Coil the long small intestine below the stomach, and run the large intestine round it.
4. Make the liver, the largest organ inside the body, from brown clay on the right side under the ribs, with a small green gall bladder beneath it. Add the pancreas behind the stomach.
5. Label each part with its job.

Part	Its job
Mouth	Teeth chew the food; saliva starts breaking down starch
Food pipe (oesophagus)	Muscles squeeze food down to the stomach
Stomach	Churns food with acid and digestive juices
Liver and gall bladder	The liver makes bile, stored in the gall bladder, which helps digest fats
Pancreas	Makes a juice that helps digest food in the small intestine
Small intestine	Finishes digestion; digested food passes into the blood
Large intestine	Takes water back from the undigested waste
Rectum and anus	Store the waste and pass it out

The science: Digestion breaks food into tiny pieces that can pass into the blood. The small intestine is long and coiled, several metres long in an adult, which gives it a huge surface for taking in digested food.

TRY THIS

Chew a small piece of plain roti for two minutes without swallowing. It starts to taste slightly sweet, because saliva is changing starch into sugar.

Viva questions: What does bile do? Helps digest fats. Why is the small intestine so long? To give a large surface for taking digested food into the blood.

CHAPTER 8

Force and sound

Project 16: Friction ramp

You need: a smooth board about 60 cm long, books, a toy car and a small wooden block, a measuring tape, a protractor, and surfaces to test: glossy paper, newspaper, a cotton cloth, a towel and sandpaper.

Steps:

1. Prop one end of the board on three books to make a ramp.
2. Cover the floor beyond the ramp with one test surface.
3. Release the car from a marked line at the top, without pushing. Measure how far it travels on the floor.
4. Repeat three times and take the average. Then change the surface.
5. **Second test:** lay the block on the board covered with each surface, and lift one end slowly until the block starts to slide. Measure the angle.

Surface	Distance (average)	Angle at which the block slides
Glossy paper		
Newspaper		
Cotton cloth		
Towel		
Sandpaper		

The science: Friction is a force that acts between two surfaces in contact and opposes movement. Rough surfaces grip more, so the car stops sooner on the towel and the block needs a steeper slope to slide on sandpaper. Rolling causes much less friction than sliding, which is why wheels matter so much. Friction can be reduced with oil, grease and ball bearings, and increased with treads on tyres and shoe soles.

Viva questions: Name two ways to reduce friction. Oil or grease, ball bearings (also polishing, wheels). Is friction always a nuisance? No. Without it we could not walk, write or brake.

Project 17: Sound and vibration

You need: a bowl, cling film, a rubber band, a few grains of rice, a steel plate and spoon, six identical glass bottles, water, a pencil, a 30 cm ruler.

Steps:

1. Stretch cling film tightly over the bowl and hold it with the rubber band. Sprinkle rice on it. Bang the plate with the spoon close by, or hum loudly near it, and watch the rice.
2. Fill the bottles with different amounts of water. Tap each one gently with the pencil and arrange them from low to high.
3. Now blow across the top of each bottle and listen to the order again.
4. Hold the ruler on the table edge with most of it sticking out and twang it. Slide it in so less sticks out and twang it again.

The science: Sound is made by **vibration**, a quick to-and-fro movement, and it travels through air, water and solids, but not through empty space. How high or low a sound is, its **pitch**, depends on how many vibrations happen each second, the **frequency**, measured in hertz. Tapping makes the bottle and water vibrate: more water gives a lower note. Blowing makes the air above the water vibrate: more water leaves a shorter air column, so the note is higher. A shorter ruler vibrates faster and gives a higher note.

Viva questions: Why did the rice jump? Sound vibrations travelled through the air and shook the film. Can sound travel in space? No. There is no air to carry it.

DID YOU KNOW

Sound travels through air at about 340 metres a second, far slower than light. That is why you see lightning before you hear the thunder.

CHAPTER 9

Plants and how they grow

Project 18: Plant growth experiment

This is an **investigatory project**: it answers a question with a fair test. Our question is: Do plants need light to grow well?

You need: three identical cups or pots with drainage holes, the same garden soil for all, moong seeds, a shoebox with a hole cut in one side, a ruler, water.

Steps:

1. Fill the three cups with the same soil. Sow five seeds in each, at the same depth.
2. Water them equally and keep them together until the seedlings appear.
3. Then put cup A on a sunny window sill, cup B in a dark cupboard, and cup C inside the shoebox with the hole facing the light.
4. Give each cup the same amount of water every day.
5. Every day for ten days, measure the tallest seedling in each cup and note the colour of the leaves.
6. Draw a line graph of height against days for each cup.

Day	Cup A: height and colour	Cup B: height and colour	Cup C: what you notice
1			
4			
7			
10			

The science: Green leaves make the plant's food from water, carbon dioxide and sunlight, giving out oxygen. This is **photosynthesis**, and the green colouring that traps the light is **chlorophyll**. In the dark, the seedlings grow tall and thin as they stretch to find light, and their leaves stay pale yellow because chlorophyll does not form without light. The seedlings in the box bend towards the hole. Growing towards light is called **phototropism**.

In a fair test, the thing you change (here, the light) is the **independent variable**. The thing you measure (the height) is the **dependent variable**. The things you keep the same, such as the seeds, soil, water and cups, are the **controlled variables**.

Viva questions: What did you keep the same? The seeds, soil, water, cups and sowing depth. Why do the seedlings in the box bend? They grow towards the light coming through the hole.

REMEMBER

Report what actually happened, even if it surprises you. An honest result explained well earns more marks than a "perfect" result.

CHAPTER 10

Presenting your project

A simple project can shine if it is explained clearly.

Your chart or display board

Set it out in the order a scientist works:

1. **Title** and your name and class.
2. **Aim:** what you set out to show or find out.
3. **Materials:** a short list.
4. **Method:** numbered steps, with a labelled diagram.
5. **Observations:** your table, and a graph if you have one.
6. **Conclusion:** what you found, in one or two sentences.
7. **Uses in daily life:** two or three examples.

Use big headings, short sentences and neat labels that can be read from two steps away.

A one-minute explanation

Practise saying this aloud until it feels natural:

EXAMPLE

"Good morning. My project is a pinhole camera. It shows that light travels in straight lines. Light from the top of an object passes through this tiny hole and reaches the bottom of the screen, so the image is upside down. I found that a bigger hole gives a brighter but blurrier image. The same idea is used in the eye and in cameras."

Facing the viva

- Read the viva questions under your project and add five more of your own.
- Be ready to explain every word on your chart.
- If you do not know an answer, say so politely and say how you would find out.
- Say honestly who helped you and with what.

TIP

Practise in front of your family and ask them to interrupt you with questions. The real viva will feel easy after that.

CHECK YOURSELF

Practice questions

1. In the circuit board quiz, why does the LED light only for the correct answer?
2. Give two ways to make an electromagnet stronger.
3. What is electromagnetic induction, and who discovered it?
4. At what angle are the mirrors in a periscope fixed, and why?
5. Why is the image in a pinhole camera upside down?

6. How many images do you see when two mirrors are at 45° ?
7. Why is the water from a sand filter not safe to drink?
8. A roof of 40 m^2 gets 600 mm of rain in a year. How much water can it collect, before losses?
9. Give three reasons why a box solar cooker gets hot.
10. Which way does the arrow of a wind vane point?
11. What colours do turmeric and China rose indicator turn in a base?
12. In the lungs model, what does pulling the rubber sheet down show?
13. Why is the wall of the left ventricle the thickest?
14. Where is most digested food absorbed into the blood?
15. Why does a toy car stop sooner on a towel than on glossy paper?
16. Why does a bottle with more water give a lower note when tapped but a higher note when you blow across it?
17. Why do seedlings grown in the dark have pale yellow leaves?
18. In the plant growth experiment, name the independent, dependent and controlled variables.

ANSWER KEY

Answers

1. A hidden wire joins each question only to its correct answer, so only that pair closes the circuit.
2. More turns of wire, more current (also a bigger iron core).
3. The production of a voltage in a coil when the magnetic field through it changes. It was discovered by Michael Faraday in 1831.
4. At 45° , so that each mirror turns the light through a right angle.
5. Light travels in straight lines, so rays from the top of the object pass through the hole and reach the bottom of the screen.
6. Seven, because $360 \div 45 - 1 = 7$.

7. Germs and dissolved substances pass through the filter. Drinking water must be boiled or properly purified.
8. $40 \times 600 = 24,000$ litres.
9. The black inside absorbs sunlight, the clear lid traps the warm air, and the reflector sends in extra sunlight (also, the newspaper insulation slows heat loss).
10. Towards the direction the wind is coming from.
11. Turmeric turns reddish-brown and China rose turns green.
12. When the diaphragm moves down, the space in the chest gets bigger, the pressure falls and air rushes into the lungs.
13. It pumps blood to the whole body, which needs the most force.
14. In the small intestine.
15. The towel is rougher, so it causes more friction.
16. Tapping vibrates the bottle and the water, and more water vibrates more slowly. Blowing vibrates the air column above the water, and more water leaves a shorter air column, which vibrates faster.
17. Chlorophyll, the green colouring, does not form without light.
18. Independent: the light. Dependent: the height of the seedlings. Controlled: the seeds, soil, water, cups and sowing depth.

WORD LIST

Glossary

Atrium

one of the two upper chambers of the heart, which receive blood (plural: atria).

Chlorophyll

the green colouring in leaves that traps sunlight.

Crystal

a solid with flat faces and a regular shape.

Diaphragm

the dome-shaped muscle below the lungs that helps us breathe.

Electromagnetic induction

the production of a voltage in a coil when the magnetic field through it changes.

Filtration

separating solid bits from a liquid by passing it through layers that trap them.

Frequency

the number of vibrations each second, measured in hertz.

Friction

a force between two surfaces in contact that opposes movement.

Greenhouse effect

the trapping of heat behind a clear cover.

Groundwater

water stored in the soil and rocks under the ground.

Indicator

a substance that changes colour in an acid or a base.

Lateral inversion

the swapping of left and right in a mirror image.

Photosynthesis

the way green plants make food from water, carbon dioxide and sunlight.

Phototropism

the growth of a plant towards light.

Pitch

how high or low a sound is.

Saturated solution

a solution in which no more substance will dissolve at that temperature.

Valve

a flap in the heart that lets blood flow only one way.

Ventricle

one of the two lower chambers of the heart, which pump blood out.

Vibration

a quick to-and-fro movement.



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