



Gurukul Technicals Institute

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FREE EBOOK

SCIENCE PROJECTS AND KITS

Tools, Materials and Safety for Model Making

Everything you need to build neat, strong and safe science models

INSIDE THIS BOOK

- Planning your model and your work corner
- Choosing a base board
- Glues and tapes
- Cutting tools and safe cutting
- ...and 7 more chapters, practice questions and a glossary

Beginner

Students, parents and teachers making models at home or school

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Tools, Materials and Safety for Model Making

A friendly handbook for students, parents and teachers on the boards, glues, cutting and measuring tools, paints, wires, switches, batteries, motors and LEDs used in school models. You will learn which material to choose and why, how to use each tool safely, what to do if someone gets hurt, and how to pack and present your model on exhibition day.

WHO IT IS FOR	Students, parents and teachers making models at home or school
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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Planning your model and your work corner

A neat, strong model starts long before you pick up a cutter. It starts with a plan on paper and a safe place to work.

Plan on paper first

1. **Write one sentence** saying what the model shows. For example: "This model shows how a wind turbine turns wind into electricity."
2. **Check the rules.** Many school and district exhibitions set a maximum size, and some ban certain materials. Ask your teacher.
3. **Draw the model from the front and the top.** Write the size of each part in centimetres.
4. **Make a list** of materials and tools. Tick off what you already have at home.
5. **Plan the time.** Glue and paint need hours to dry. Leave at least two spare days before the exhibition.

EXAMPLE

Tanvi in Nashik planned a rainwater harvesting model on a 60 cm × 45 cm board. Her list showed she already had cardboard, poster colours and a plastic bottle. She needed to buy only a sunboard sheet, a glue gun stick pack and some sand. Planning saved her money and two trips to the shop.

Set up a safe work corner

- Use a sturdy table with good light, near a window if possible for fresh air.
- Cover the table with old newspaper, and put a cutting mat or thick card where you will cut.
- Keep tools in a box or tray, not loose on the table.
- Keep a small bin for scraps and a damp cloth for glue and paint.
- Keep the area away from small children and pets, and from food.

A basic kit

Group	Items
Measuring and marking	Steel ruler, measuring tape, set square, protractor, compass, pencils, eraser
Cutting	Scissors, snap-off blade cutter, cutting mat, junior hacksaw (for adults)
Joining	White glue, glue gun and sticks, double-sided tape, masking tape
Finishing	Poster colours or acrylic paints, brushes, sandpaper
Electrical	Battery holders, switches, wire, LEDs, resistors, small motors
Safety	First aid kit, safety glasses, dust masks

REMEMBER

A good plan prevents most mistakes. A tidy table prevents most accidents.

TIP

Keep a "model box": a shoebox where all the small parts for one project live until it is finished. It stops screws, LEDs and labels from vanishing.

CHAPTER 2

Choosing a base board

The base board holds everything. If it bends, cracks or is too heavy to carry, the whole model suffers. Here are the four most common choices.

Cardboard

Cardboard from old cartons is free and easy to cut. Corrugated cardboard (with a wavy layer inside) is stiffer than flat card. It bends if it gets damp and it can sag under weight.

TIP

Glue two sheets of corrugated cardboard together with the waves running in different directions: one lengthwise, one across. The base becomes much stiffer.

Foam board

Foam board is a sheet of light plastic foam sandwiched between two sheets of smooth paper. It is very light, cuts cleanly with a sharp cutter, and looks neat. It dents if pressed hard, and some solvent-based glues and spray paints melt the foam inside.

Sunboard

Sunboard is a white sheet of foamed PVC plastic, sold in different thicknesses. It is smooth, rigid, waterproof and takes paint well. You cut it by scoring it several times with a cutter. It is heavier than foam board but much tougher, which makes it a favourite base for exhibition models.

MDF

MDF (medium-density fibreboard) is a board made from fine wood fibres pressed together with glue. It is flat, strong and heavy. It needs a saw to cut, and the fine dust it makes should not be breathed in. An adult should cut it, outdoors or with a dust mask, and the edges should be sanded.

Thickness and size

Thicker sheets are stiffer but heavier. For most table-top models, a sheet about 5 mm thick is a good place to start. Models with motors, water or many heavy parts need thicker sunboard or MDF. Cut the base about 5 cm bigger than the model on every side, so there is room for labels and for your hands when you carry it.

Comparing them

Board	Weight	Strength	Cutting	Water	Best for
Cardboard	Light	Low to medium	Easy	Poor	Practice models, light models
Foam board	Very light	Medium	Easy with sharp blade	Poor	Neat display boards, light structures

Board	Weight	Strength	Cutting	Water	Best for
Sunboard	Medium	Good	Moderate	Good	Most exhibition models, water models
MDF	Heavy	Very good	Saw, by an adult	Poor unless painted	Models with motors, heavy parts or wheels

DID YOU KNOW

Thermocol (expanded polystyrene) was once the usual choice, but it crumbles, sheds tiny beads, and does not break down in the environment. Many schools now prefer cardboard, sunboard or MDF.

TRY THIS

Before buying, place your heaviest parts on a sample of the board and lift it from one corner. If it bends, choose a thicker or stronger board.

CHAPTER 3

Glues and tapes

Using the right glue is the difference between a model that lasts and one that falls apart on the way to school.

White glue (PVA)

PVA glue is the white, water-based glue sold in bottles and tubes, often called by the brand name Fevicol. It is safe to use, cleans up with water while wet, and dries almost clear. It is slow: parts need holding or weighting for some time, and the joint reaches full strength only after several hours, often overnight.

- **Good for:** paper, card, cardboard, wood, MDF, fabric, foam board and sand textures.
- **Not good for:** smooth plastics and metal.

Hot glue

A glue gun melts sticks of glue. The glue sets as it cools, in under a minute. It fills gaps and is excellent for quick, strong joins and for holding motors, wires and battery holders in place.

- **Good for:** cardboard, wood, fabric, many plastics, fixing parts.
- **Watch out:** the glue and the nozzle are hot enough to burn. A low-temperature glue gun is safer for children and does not melt foam as easily.

SAFETY

Children should use a glue gun only with an adult beside them. Always rest it on its stand, never on its side. Do not touch the nozzle or fresh glue. Unplug it as soon as you finish, and let it cool in a safe place.

Instant glue

Instant glue (cyanoacrylate) bonds in seconds. A tiny drop joins hard plastic, metal, rubber and ceramic. It is brittle, it gives off fumes that sting the eyes, it melts thermocol, and it sticks skin together instantly. It is for older students and adults only.

Tapes

- **Double-sided tape:** clean and instant, for labels, paper and light parts.
- **Foam mounting tape:** thick double-sided tape that raises a label off the board and holds light boxes and battery holders.
- **Masking tape:** paper tape that peels off easily, for holding parts while glue dries and for papier-mâché frames.
- **Insulation tape:** for covering bare wire joints.

Which glue for which job?

Joining	Best choice	Also works
Paper to card	Glue stick or white glue	Double-sided tape
Cardboard to cardboard	White glue	Hot glue
Anything to sunboard	Hot glue	Instant glue for small parts

Joining	Best choice	Also works
Wood or MDF to wood	White glue, clamped	Hot glue for light parts
Motor or battery holder to base	Hot glue	Foam mounting tape
Small plastic parts	Instant glue (adult)	Hot glue
Labels	Double-sided tape	Foam tape for a raised look

REMEMBER

Thin coats of glue hold better than thick blobs. Press the parts together firmly and give them time.

CHAPTER 4

Cutting tools and safe cutting

Most model-making injuries are small cuts. Nearly all of them can be avoided by using the right tool in the right way.

Scissors

Use scissors for paper, thin card and fabric. Young children should use round-tipped scissors. Cut with the middle of the blades, not the tips, and keep your other hand out of the path.

Snap-off blade cutter

A cutter has a long blade divided into segments. When the tip gets blunt, an adult snaps off the old segment, using pliers or the slot provided in some cutters, so a fresh sharp point is ready. A sharp blade is safer than a blunt one, because it needs less force and does not slip.

How to cut safely with a cutter

1. Put the work on a cutting mat or a thick piece of card.
2. Push out only one or two segments of the blade.

3. Hold a steel ruler firmly along the line, with your fingers spread flat and well away from the edge.
4. Cut **away** from your body and away from the hand holding the ruler.
5. Make several light cuts instead of one hard cut. On sunboard and thick card, the third or fourth pass goes through.
6. Slide the blade back in after every cut, even if you will use it again in a minute.

SAFETY

Children should use a cutter only with an adult watching. Never cut towards your hand, your lap or another person. Never carry a cutter with the blade out. Wrap snapped-off blade pieces in tape before putting them in the bin.

Saws

A junior hacksaw cuts thin wood, MDF strips, PVC pipe and plastic rods. A coping saw cuts curves in thin wood. Clamp the work to the table so both hands are free to control the saw, and let the saw do the work with steady strokes. Saws are for adults, or older students with an adult present.

Cutting curves and circles

Draw the circle with a compass. Cut it with many short, shallow cuts that follow the line, turning the sheet as you go, rather than trying to swing the blade round in one go. Smooth the edge with fine sandpaper wrapped around a pencil.

Making holes

For holes in card or sunboard, place the sheet on an eraser or a piece of cork and push through gently with a compass point or a sharp pencil. For bigger holes, an adult can use a hand drill.

TIP

Cut on the waste side of your pencil line, not on it. Then the piece you keep is exactly the right size.

TRY THIS

Practise on scrap first. Cut ten straight strips from a waste piece of sunboard before cutting your real base. Your cuts will be straighter and your hands steadier.

CHAPTER 5

Measuring and marking

Neat models come from careful measuring. A gap of 2 mm at a corner shows from across the room.

Tools for measuring

Tool	Use
Steel ruler (30 cm or longer)	Measuring and as a straight edge for cutting
Measuring tape	Long distances and curved surfaces
Set square	Drawing right angles and checking corners
Protractor	Measuring and drawing angles
Compass	Drawing circles and arcs
Sharp pencil	Fine, accurate lines that can be erased

REMEMBER

Measure twice, cut once. A wrong measurement costs only a pencil line. A wrong cut costs a whole sheet.

Good marking habits

- Use a sharp pencil, not a pen or marker. Thick lines make thick mistakes.
- Mark on the back of the sheet, so pencil lines do not show on the finished side.
- Measure every mark from the same starting edge, not from the last mark. Small errors otherwise add up.
- Label each piece lightly in pencil: "left wall", "roof".

Useful tricks

Finding the centre of a board: Draw lines joining opposite corners. The point where they cross is the centre.

Checking a right angle with 3-4-5: Mark 30 cm along one edge and 40 cm along the other edge from the same corner. If the distance between the two marks is exactly 50 cm, the corner is a perfect right angle. This works for any multiple of 3, 4 and 5.

Measuring round things

To find how long a strip must be to wrap around a bottle or a tube, wrap a piece of thread around it, mark where it meets, and measure the thread. Or measure across the circle (the diameter) and multiply by 3.14.

EXAMPLE

A strip to go round a bottle 7 cm across must be about $7 \times 3.14 = 22$ cm long. Add 1 cm for the overlap, so cut it 23 cm.

Working to scale

A scale model is smaller than the real thing by the same amount everywhere. You can write the scale as a ratio, such as 1:20, which means 1 cm on the model stands for 20 cm in real life.

EXAMPLE

Kabir in Lucknow is modelling a classroom 8 m long and 6 m wide at a scale of 1:20. 8 m is 800 cm, and $800 \div 20 = 40$ cm. 6 m is 600 cm, and $600 \div 20 = 30$ cm. His floor will be 40 cm $\times$ 30 cm, which fits nicely on a 50 cm $\times$ 40 cm base.

DID YOU KNOW

Many architects and engineers still make quick pencil sketches before they turn to computers, because a rough drawing shows problems early.

Colours and finishes

Paint makes a model look finished. It also protects card and wood from dirt and damp.

Types of paint

Paint	What it is like	Best for
Poster colours	Water-based, bright, matte, cheap. Smudges if it gets wet	Paper, card, charts
Acrylic paint	Water-based when wet, water-resistant when dry. Good coverage	Sunboard, MDF, papier-mâché, plastic parts
Spray paint	Very smooth, quick finish	Large areas, by adults only, outdoors
Clear varnish	A clear protective coat	Protecting painted parts

Painting step by step

1. **Sand** rough edges and wipe away dust with a dry cloth.
2. **Prime** surfaces that soak up paint, such as cardboard and MDF edges. A coat of white acrylic, or white glue mixed with a little water, works well.
3. **Paint large areas first** with a wide brush, in thin, even coats.
4. **Let each coat dry** before adding the next one.
5. **Add details last** with a fine brush.
6. **Wash brushes** in water as soon as you finish. Dried acrylic ruins a brush.

SAFETY

Spray paint must be used only by an adult, outdoors, with a mask, away from flames, with the model on newspaper and nobody downwind. Spray paint also melts thermocol and the foam inside foam board.

Textures and realistic effects

- **Ground and roads:** sprinkle fine sand onto wet white glue, then paint.
- **Grass:** sawdust mixed with green paint and dried, then glued on.
- **Water:** blue paint with a coat of clear varnish or glue on top for a shine.
- **Rocks:** crumpled paper or papier-mâché painted grey and brown.
- **Clouds and smoke:** stretched cotton wool.
- **Trees:** sponge pieces painted green on toothpick or twig trunks.

TIP

Use colours that carry meaning: blue for water, green for plants, brown for soil, red for heat or danger, yellow for light. Judges understand a model faster when its colours make sense.

TRY THIS

Paint a test strip of your base material before painting the model. Some boards soak up paint and need two or three coats.

CHAPTER 7

Wires, switches and battery holders

Many models light up, spin or make a sound. They need a simple, safe electric circuit.

What a circuit is

A circuit is a complete loop that electricity flows around. It goes from the battery, through a switch, through the part that does the work (an LED, motor or buzzer), and back to the battery. If the loop is broken anywhere, nothing works.

Wires

- **Single-strand wire** has one solid copper core. It holds its shape and fits breadboards well.
- **Multi-strand wire** has many thin copper strands. It is flexible and better for parts that move.

- Use **red for positive** and **black for negative**. Anyone can then follow your circuit.

To strip a wire, remove about 1 cm of plastic covering with a wire stripper. Twist the bare strands together so they do not fray.

Joining wires

- **Terminal blocks** (screw connectors): push wires in and tighten. Neat, safe and easy to undo.
- **Twist and tape:** twist the bare ends together tightly and cover fully with insulation tape.
- **Soldering:** the strongest join, using a hot soldering iron. An adult must do it or supervise closely.

Switches

Switch	How it works	Use
Slide or toggle switch	Stays on or off	Main power switch
Push button	On only while pressed	Bell, demonstration button
Rocker switch	Stays on or off, rocks side to side	Main switch on bigger models
Reed switch	Closes when a magnet comes near	Door alarm, hidden switch

Batteries and holders

Battery	Voltage	Notes
AA or AAA cell	1.5 V	Use in holders of 2 (3 V) or 4 (6 V)
Rechargeable AA (Ni-MH)	1.2 V	Good value for models used often
9 V battery	9 V	Fine for LEDs and buzzers, runs down fast with motors
Coin or button cell	1.5 V or 3 V	Small lights; dangerous if swallowed

Cells in a row (series) add their voltages: two 1.5 V cells give 3 V.

SAFETY

Never join the two ends of a battery directly with a wire. This is a short circuit: the wire gets very hot and the battery can leak or burst. Do not mix old and new cells, or different types. Never charge cells that are not marked rechargeable. Keep coin cells away from small children; if one is swallowed, go to a hospital at once. Never connect any model to a wall socket.

REMEMBER

Electricity needs a complete loop. If your model does not work, follow the loop with your finger from battery and back, checking every joint.

CHAPTER 8

Motors and LEDs

LEDs

An LED (light-emitting diode) is a small, bright, cool light that uses very little power. It works only one way round.

- The **longer leg** is positive. It is called the anode.
- The **shorter leg** is negative. It is called the cathode. The rim of the LED is often flat on this side.
- An LED always needs a **resistor** in series to limit the current. Without one, it can burn out in a moment.

Choosing the resistor

Use this rule: resistance = (battery voltage – LED voltage) ÷ current.

- A red LED needs about 2 V. White and blue LEDs need about 3 V.
- A safe current for a common small LED is about 15 mA, which is 0.015 A.

EXAMPLE

Aditi in Bhubaneswar wants a red LED on a 9 V battery. Resistance = $(9 - 2) \div 0.015 = 467 \, \Omega$. The nearest common value above that is $470 \, \Omega$, with colour bands yellow, violet, brown. On two AA cells (3 V), the same LED needs $(3 - 2) \div 0.015 = 67 \, \Omega$, so a $68 \, \Omega$ or $100 \, \Omega$ resistor works.

For several LEDs, connect each one with its own resistor. Do not share one resistor between LEDs in parallel.

Motors

Small DC motors, the kind found in toys, run on about 3 V to 6 V. They spin fast but have little strength.

- **To reverse a motor**, swap its two wires.
- **For wheels and slow, strong movement**, use a geared motor, often called a BO motor. The gears slow it down and make it stronger.
- **For fans and wind turbines**, a plain DC motor works well.
- **Fix motors firmly** with hot glue or a clamp, so they do not shake loose.

DID YOU KNOW

A small DC motor also works the other way round. Spin its shaft and it produces a small voltage. That is how a model wind turbine can light an LED.

Power for motors

Motors need much more current than LEDs. Use AA cells in a holder, not a 9 V battery, which runs down quickly with motors.

SAFETY

Keep fingers, hair and loose clothing away from spinning fan blades and gears. Fit a guard of card or wire mesh around any fast-moving part that visitors could touch.

TRY THIS

Connect a motor to two AA cells and note the speed. Now use four. It spins faster. Now try one cell. This shows how voltage affects a motor's speed.

Labels and printing

A model without labels makes visitors guess. Clear labels let your model explain itself, even when you step away.

What to label

- A **title** for the whole model.
- A **label** for every important part.
- A small "**How it works**" card with three to five short points.
- Your **name and class**, if the exhibition asks for it.

Make labels easy to read

Item	Suggested size
Title	72 point or bigger
Headings on charts	36 to 48 point
Part labels	24 to 28 point
Short explanation text	At least 18 point

These sizes are a good starting point for reading from one to two metres away. Print a test page and check it from that distance.

- Use a plain, clear font, not a curly decorative one.
- Use dark letters on a light background.
- Keep labels short: "Solar panel", not "This is the solar panel of the model".
- Use the same font and colour for every label, so the model looks planned.

Printing and protecting

Print at home or at a local print shop. Lamination, sealing a page in clear plastic, protects labels from fingerprints and spills.

EXAMPLE

Faisal in Hyderabad needed one A3 title sheet and twelve small labels on two A4 sheets. If an A3 colour print costs, say, ₹ 40, each A4 print ₹ 10 and lamination ₹ 20 a sheet, he pays ₹ 40 + ₹ 20 for the prints and $3 \times ₹ 20 = ₹ 60$ for lamination, a total of ₹ 120. Prices differ from shop to shop, so ask first.

The "How it works" card

Keep it to a few short, numbered steps that a visitor can read in half a minute. For a wind turbine model, it might say:

1. Wind pushes the blades and turns them.
2. The blades turn the shaft of a small motor.
3. The spinning motor works as a generator and makes electricity.
4. The electricity lights the LED.

Fixing labels

- Stick labels with double-sided tape, or foam tape for a raised look.
- For small parts, make toothpick flags: fold a strip of label around a toothpick and push it in.
- Use thin black lines or arrows to point from a label to its part.

TIP

Read every label aloud before printing. Check spelling, units (cm, V, mm) and the names of scientific terms. One spelling mistake on a big title is the first thing a judge notices.

REMEMBER

Handwritten labels are fine if they are neat. Use a stencil or a ruler to keep letters straight and the same size.

Workshop safety rules and first aid

Model making is safe when everyone follows a few simple rules. Read these together as a family or class before you start.

Safety rules for children

1. Work only when an adult knows what you are doing.
2. Use cutters, saws, glue guns, instant glue, soldering irons and spray paint only with an adult present.
3. Keep blades retracted and tools in their box when you are not using them.
4. Point sharp tools away from yourself and others.
5. Tie back long hair and roll up loose sleeves.
6. Keep the window open when using glue or paint.
7. Do not eat or drink at the work table.
8. Wash your hands after every session.
9. Use only batteries, never a wall socket, to power a model.
10. Keep small parts and coin cells away from younger brothers and sisters.

SAFETY

If something feels dangerous, stop and ask an adult. There is no prize for finishing a model with an injury.

A small first aid kit

Keep these in a box near the work corner: adhesive bandages, sterile gauze pads, medical tape, antiseptic liquid, cotton, small scissors, disposable gloves and a clean cloth.

Small cuts

1. Press a clean cloth or gauze firmly on the cut until the bleeding stops.
2. Rinse gently with clean water.
3. Cover with a bandage.

If a cut is deep, gaping or will not stop bleeding, see a doctor.

Burns from hot glue or a soldering iron

1. Cool the burn under cool running tap water for about 20 minutes.
2. Remove rings or tight items near the burn before it swells.
3. Do not put ice, butter, toothpaste or oil on it.
4. Do not peel off hot glue stuck to the skin. Cool it with water and let a doctor deal with it if it will not come off easily.
5. Cover loosely with clean cling film or a clean, non-fluffy cloth.

See a doctor for any burn that is larger than a coin, on the face or hands, or blistering badly.

Glue, paint and other splashes

- **Instant glue on fingers:** soak in warm soapy water and gently roll the skin apart. Never pull it hard.
- **Anything in the eye:** rinse with plenty of clean running water for at least 15 minutes and get medical help.
- **Leaked battery:** do not touch the crusty powder. Wear gloves to remove the battery, and wash your hands.

REMEMBER

In an emergency in India, call 112. Tell them what happened and where you are.

CHAPTER 11

Packing, transport and exhibition day

Many good models are damaged between home and school. A little planning gets yours there in one piece.

Build for the journey

- Make the base a little bigger than the model, so you can hold the edges without touching the parts.

- Fix every part firmly. If it moves when you tilt the base, it will fall off in an auto-rickshaw.
- Make tall or delicate parts removable, such as a windmill tower that slots into a hole.
- Add two card or wooden strips under the base as handles.

Packing

1. Take photos of the finished model from all sides. They help if you need to repair it.
2. Remove the batteries and pack them separately.
3. Find a box a little bigger than the model. Tape the base to the bottom of the box.
4. Fill gaps with crumpled newspaper or bubble wrap, especially around tall parts.
5. Pack loose and removable parts in labelled zip bags.
6. Mark the box "This side up" and "Fragile" on every side.

TIP

Carry the model flat on your lap or between two people. Never put it in a car boot or under a bag. If rain is possible, keep a large plastic sheet or bag to cover the box, because cardboard, paper labels and poster colours are spoiled by water.

A repair kit for the day

Pack a small bag with white glue, double-sided tape, masking tape, scissors, spare batteries, spare LEDs, a few wires, insulation tape, a marker, a cloth and a small first aid kit. Hot glue guns need a socket, so ask the teacher whether one will be available rather than counting on it.

Exhibition-day checklist

Tick each item the night before.

Item	Why you need it
Model packed, base taped to the box	So it cannot slide and break on the way
Fresh batteries, packed separately	So the model works and nothing shorts in the box
Removable parts in labelled bags	So nothing small gets lost

Item	Why you need it
Title, labels and "How it works" card	So visitors understand the model without you
Repair kit	For quick fixes after the journey
Two-minute talk, practised aloud	So you sound confident when judges arrive
Photos of the finished model	To guide any repair
Water bottle and a snack	Exhibitions are long days

On the day

1. Arrive early and set up calmly.
2. Fit the batteries and test everything once before visitors arrive.
3. Hide loose wires under the board or behind parts.
4. Keep the table clear of bags and wrappers.
5. Switch the model off between demonstrations, to save the batteries.

EXAMPLE

At a district science fair in Ranchi, a blade of Ishaan's wind turbine snapped as he unpacked it. Because he had packed glue and tape and had photos of the original, he rebuilt it in ten minutes and was ready before the judges reached his table.

REMEMBER

Judges may ask you to show the model working more than once. Fresh batteries and a quick test before they arrive make that easy.

CHECK YOURSELF

Practice questions

1. Name three things you should do before you start building a model.
2. Why should two sheets of corrugated cardboard be glued with their waves running in different directions?

3. What is sunboard, and why is it popular for exhibition models?
4. Why should an adult cut MDF?
5. Which glue would you use to join cardboard to cardboard?
6. Which glue sets in under a minute and fills gaps?
7. Give two reasons why instant glue is only for older students and adults.
8. Why is a sharp blade safer than a blunt one?
9. Which direction should you always cut with a cutter?
10. Why should you cut on the waste side of the pencil line?
11. How can you check that a corner is a right angle using 3, 4 and 5?
12. A room 10 m long is modelled at a scale of 1:50. How long is the model?
13. Why should cardboard and MDF edges be primed before painting?
14. How would you make realistic ground or roads on a model?
15. Why should wires be coloured red and black?
16. What is a short circuit, and why is it dangerous?
17. Which leg of an LED is positive?
18. Find the resistor needed for a red LED (2 V) on a 6 V supply at 0.015 A.
19. How do you reverse the direction of a small DC motor?
20. Why should a 9 V battery not be used to run a motor?
21. What size should part labels be for reading from one to two metres?
22. What is the first aid for a burn from a hot glue gun?
23. What should you do with the batteries before packing a model?

Answers

1. Any three: write what the model shows, check the exhibition rules, draw the model with sizes, list materials and tools, and plan the time including drying time.
2. Each sheet is stiff in a different direction, so together they make a base that resists bending both ways.
3. Sunboard is a foamed PVC sheet. It is smooth, rigid, waterproof and takes paint well.
4. It needs a saw, and the fine dust it makes should not be breathed in.
5. White glue (PVA), or hot glue for a quicker join.
6. Hot glue from a glue gun.
7. Any two: it sticks skin together instantly, its fumes sting the eyes, and it melts thermocol.
8. A sharp blade needs less force, so it is less likely to slip.
9. Away from your body and away from the hand holding the ruler.
10. So the piece you keep is exactly the size you marked.
11. Mark 30 cm along one side and 40 cm along the other from the corner. If the marks are exactly 50 cm apart, the corner is a right angle.
12. 10 m is 1,000 cm, and $1,000 \div 50 = 20$ cm.
13. They soak up paint, so a primer coat seals them and the paint goes on evenly.
14. Sprinkle fine sand onto wet white glue, let it dry, then paint it.
15. So anyone can easily see which wire is positive and which is negative.
16. It is when the two ends of a battery are joined directly by a wire. The wire gets very hot and the battery can leak or burst.
17. The longer leg, called the anode.
18. $(6 - 2) \div 0.015 = 267 \Omega$, so use the next common value above it, such as 270Ω or 330Ω .
19. Swap its two wires.
20. Motors draw a lot of current, and a 9 V battery runs down quickly when it supplies that much.
21. About 24 to 28 point.
22. Cool it under cool running tap water for about 20 minutes, do not use ice, butter or toothpaste, and see a doctor if it is large, on the face or hands, or blistering.
23. Remove them and pack them separately.

Glossary

Base board

the flat board that holds all the parts of a model.

Corrugated cardboard

cardboard with a wavy layer inside that makes it stiffer.

Foam board

a light sheet of plastic foam between two layers of smooth paper.

Sunboard

a rigid, waterproof sheet of foamed PVC plastic.

MDF

medium-density fibreboard, a heavy, flat board made from wood fibres and glue.

PVA glue

white, water-based glue that dries almost clear.

Hot glue

glue melted in a glue gun that sets as it cools.

Instant glue

cyanoacrylate glue that bonds in seconds.

Snap-off blade cutter

a cutter whose blade is divided into segments that can be snapped off when blunt.

Set square

a triangle-shaped tool for drawing and checking right angles.

Scale

the ratio between the size of a model and the real thing, such as 1:20.

Primer

a first coat that seals a surface so paint goes on evenly.

Acrylic paint

water-based paint that becomes water-resistant when dry.

Circuit

a complete loop that electricity flows around.

Series

connected one after another in a single line.

Short circuit

a direct connection between battery terminals, which causes dangerous heating.

Terminal block

a connector that holds wires with small screws.

LED

a light-emitting diode, a small light that works only one way round.

Anode

the positive leg of an LED, usually the longer one.

Resistor

a part that limits the current in a circuit.

Geared motor

a motor with gears that make it turn slower and more strongly.

Lamination

sealing a printed page in clear plastic to protect it.

Point

the unit used to measure the size of printed letters.



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