Build-a-House

Lesson Plan

Build-a-House

- Recommended level – Years 4-6
- Time taken – 5-6 hours
- Pupils to work individually
- Additional adult help is useful – you could invite in parent helpers
- Expectation – each pupil to complete one working house

Skills and Learning

STEM Links

- **S**cience – construct simple series circuits; use their circuits to create simple devices.
- **T**echnology – design, make and evaluate; understand and use electrical systems in products.
- **E**ngineering – doorbell and lamp circuits, different types of switches and their uses.
- **M**aths – draw lines to the nearest mm, measure angles using a protractor.

Curriculum Learning Objectives – it is recommended to cover these topics prior to the exercise so that the pupils are reinforcing their knowledge and understanding, rather than meeting the topics for the first time.

Science: Electricity
(Years 4 & 6)

Pupils should be taught to:

- construct a simple series electrical circuit, identifying and naming its basic parts
- recognise that a switch opens and closes a circuit
- recognise some common conductors and insulators, and associate metals with being good conductors.
- use their circuits to create simple devices
- use recognised symbols when representing a simple circuit in a diagram
- pupils should be taught about precautions for working safely with electricity

Design and Technology
(Key Stage 2)

Through a variety of creative and practical activities, pupils should be taught the knowledge, understanding and skills needed to engage in an iterative process of designing and making. When designing and making, pupils should be taught to:

Design and Technology: Design

- design innovative, functional, appealing products that are fit for purpose.

Design and Technology: Make

- select from and use a wide range of tools and equipment to perform practical tasks.
- select from and use a wide range of materials and components according to their functional properties and aesthetic qualities.

Design and Technology: Evaluate

- evaluate their ideas and products

Design and Technology: Technical Knowledge

- understand and use electrical systems in their products.

Mathematics

Pupils should be taught to:

- Draw lines with a ruler to the nearest mm
- Measure angles in degrees (°) using a protractor

Resources

Parts included in class kit per house:

- 1 cardboard box (total 30)
- 1 buzzer (total 30)
- 1 push-to-make switch (total 30)
- 1 bulb holder with bulb (total 30 bulb holders, 50 bulbs)
- 1 slide switch (total 30)
- 6 crocodile leads (total 180)
- 2 battery holders (total 60)
- 25 cm square of corrugated plastic sheet
- 12.5 cm square of corrugated plastic sheet & offcuts of corrugated plastic sheet (total 1 pack of coloured corrugated plastic sheet containing 10 sheets 500mm x 500mm)
- Self-adhesive foam sheet (total 1 pack of 10 coloured sheets 200mm x 300mm)
- Pipe cleaners (total 1 large pack)
- Pompoms (total 1 large pack)
- Wiggly eyes (total 560)

Check you have received the correct contents in your class kit. Please let TTS know if there are any problems as soon as possible.

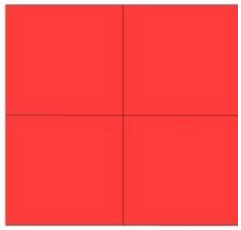
Associated resources:

- Build-a-House Presentation – this is to be followed when running the activity in class.
- Build-a-House worksheet – print out one worksheet for each pupil. Suggested answers are given at the end of the lesson plan below – these are for teacher reference only.
- How to build-a-house instructions – this is for teacher reference only.

Tools and consumables (not included):

- AA cell (this is often called a battery). It is very important to use **zinc chloride** or similar type of cells, **not** alkaline or re-chargeable ones. If the pupils accidentally short circuit their battery (which often happens) then alkaline or re-chargeable cells get hot and can cause burns. Zinc chloride type cells are cheap and easily available (e.g. from discount stores).
- Pointed scissors, e.g. nail scissors. The scissors need to be pointed in order to pierce the cardboard – most school scissors are too rounded for this.
- Large scissors
- 30cm ruler
- Felt tip pen
- Protractor
- Sharp pencil
- Blunt pencil (or crayon)
- Transparent sticky tape 25 mm wide (preferably one tape dispenser per table)
- Pair of pliers or a 10 mm spanner (preferably one per table – however if you have strong fingers, you can probably manage without)
- Low melt glue guns and glue sticks (several needed, e.g. 5-6, as there is likely to be a large queue to use them!). **Note: High melt temperature glue guns should not be used, as they can cause nasty burns.**
- Optional – you could ask pupils to collect transparent plastic sheet, e.g. the display panel from cake or biscuit boxes, to use for window glazing. Also pine cones and other decorations.

Preparation Needed:



- Take the two black sheets of corrugated plastic and use a craft knife, straight edge and cutting mat to cut them each into 16 squares (12.5 cm x 12.5 cm).
- Take the remaining eight sheets of corrugated plastic and cut them each into 4 squares (25 cm x 25 cm).
- Build a sample house to explore any pitfalls. Instructions are given in the 'How to Build-a-House' Instructions. If you have 30 pupils, you will need to dismantle your house to re-use the parts.
- Lay out the electrical parts in trays (e.g. re-use clean plastic food trays) for the pupils to collect.
- Use bowls or use plastic food trays for the pupils to collect their electrical parts in. Then they are less likely to drop or lose them, particularly when dismantling the switch.
- Print out a worksheet per pupil.
- You could screw the bulbs into the bulb holders in advance, so they don't get dropped or lost.

Hints and tips

Glue Guns

- Allow ten minutes for them to warm up before use. You can jam the glue guns by trying to use them before they are fully warm.
- Do not use the glue guns after they have been switched off, as you could jam them while they are cooling down.
- Keep spare glue sticks in a bag or box. If you leave them out on the gluing station, they can get glue on and then jam the glue gun when inserted.
- Keep the glue guns spaced well apart to avoid gluing up the glue stick of the gun next to them.
- Don't pull the glue sticks out of the glue guns, as you could damage them.

Vocabulary list:

- ***Battery / cell*** – this converts chemical energy into electrical energy. It is used to 'push' electricity around a circuit. If you connect cells together you get more 'push' – a battery consists of two or more cells.
- ***Conductor*** – an electrical conductor allows electricity to flow through it. Metals are good conductors.
- ***Insulator*** – an electrical insulator stops electricity passing through. Plastic, wood, rubber and glass are insulators.
- ***Push-to-make switch*** – this is a switch which allows electricity to flow only when the button is being pressed.
- ***Slide switch*** – this switch is operated using a slider. When the slider is pushed to one end of the switch the electricity can flow, and when pushed to the other end it can't.
- ***Short circuit*** – an electric circuit which allows the electricity to flow round it with very little resistance,

Risk Assessment:

Conduct a risk assessment before undertaking the activity. A sample risk assessment is given below; you can use this as a starting point when writing your own.

Activity	Identified Hazard	Initial Risk Rating L/M/H	Control Measures	Controlled Risk Rating L/M/H
Use of glue guns	Burns	H	• Children should be supervised by a responsible adult at all times when using the glue guns. • Explain to children how to use the glue guns. • Warn them that the ends are very hot. Use only low melt temperature glue guns. If burned hold under running water for ten minutes. • Don't switch on the glue guns until after the safety briefing. • In some schools, children wear safety goggles when using glue guns.	M
Accidentally short-circuiting battery	Burns, smoke inhalation	M	• Explain how to avoid short circuits. • Use only zinc chloride cells, not alkaline or re-chargeable ones as these can get very hot if short circuited.	L
Use of pointed scissors	Injury e.g. to fingers	M	• Make the children aware of the dangers. • Do not give out the scissors until after the safety briefing.	L
Use of sharp pencils	Injury, e.g. to fingers	M	• When piercing holes in plastic or cardboard it is possible to injure your fingers. • Explain the dangers to the children and tell them to take care.	L
Use of tape dispensers	Injury, e.g. to fingers	M	• Make the children aware of the dangers. • Show them how to use the tape dispensers safely.	L
Running extension leads along floor for glue guns	Trip hazard	M	• Avoid using extension leads if possible. • Otherwise make sure extension leads are run where they cannot be tripped over.	L
Damaged extension leads or glue gun leads	Electrocution hazard	H	• Conduct a visual check of all electrical items before session, to ensure the leads are undamaged.	L

Teacher notes – referring to the relevant numbered slides in the Presentation

Slide 5	**Electrical Parts** • You could hold up each electrical component and ask pupils to name it. • Point out the relevant circuit symbol shown below each of the electrical components.
Slide 6	**Electrical Circuit** • How to operate the push-to-make switch – you press the button to allow electricity to flow around the circuit. When you release the button, the electricity stops flowing. • How to operate the slide switch – you push the slider to one end to allow electricity to flow around the circuit. When you push it to the other end the electricity stops flowing. • A circuit diagram is easier to draw and to interpret than drawing the actual circuit and components.
Slide 7	**How a push-to-make switch works** • Explain that, if the spring contacts are connected into a complete circuit, when the button is pressed, the circuit will be switched on. When the button is released, the circuit will be switched off.
Slide 8	**How a slide switch works** • Explain that, if the left and central contacts only are connected into a complete circuit, when the slider is to the left, the circuit will be switched on. When the slider is to the right, the circuit will be switched off.
Slide 9	**Avoid short circuits** • Explain what a short circuit is. If the wires from the battery are accidentally connected together, there is very little resistance to the flow of electricity, and the battery can get hot and drain quickly. That is why the wires from the battery need to be connected across components such as the bulb or the buzzer which resist the flow of electricity.
Slide 10	**Make your doorbell circuit** • It is helpful to lay out a set of components in a triangle and then demonstrate how to connect them up and fit the cells. • Only lay out the electrical parts needed for the buzzer circuit at this stage. • Pupils can then go and collect their electrical parts in a bowl or tray, so they don't drop or lose them. • It is useful for the pupils to collect wires of three different colours, including one red one. This makes it easier to identify exactly which is connected to what. • Pupils can bend the contacts of the switch apart a little to fit the crocodile clips on. The metal ends of the crocodile clips mustn't be touching.

	• If the buzzer is connected back to front, it won't do any harm – it just won't buzz! • Pupils often clip the crocodiles onto the plastic insulation instead of the bare metal ends of the wires. This makes a useful demonstration of conductors versus insulators!
Slide 12	**Make your doors and windows** • Only hand out the pointed scissors at this stage, not the large scissors, so the pupils can't use the wrong ones.
Slide 13	**Prepare your doorbell attachment** • Hand out only the sharp pencils at this stage; blunt pencils are likely to just bend the plastic.
Slide 14	**Fit your push-to-make switch** • Make sure the pupils place their nuts and washers in their bowl, so they don't lose them. • If the nut is very tight, they may need to loosen it with the pliers or spanner.
Slide 15	**Fit your buzzer and re-make the circuit** • Don't fit the buzzer too close to the roof line or it can stop the roof from fitting on properly.
Slide 16	**Make your lighting circuit** • Lay out just the parts needed for the lighting circuit. • Advise the pupils to collect wires of three different colours to help them work out what is connected to what. • If you haven't screwed bulbs into the bulb holders beforehand then ask the pupils to screw them in right away before they lose or drop them. • If the bulbs don't light up, they may not be screwed in hard enough. • It doesn't matter which way round you connect the bulb.

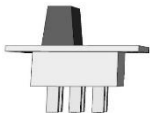
Slide 19	**Electrical safety** • Hazards include electrical shocks, electrocution and electrical fires. • Possible ways to avoid electric shocks include: don't put your fingers in plug sockets; switch off at the socket before unplugging devices; switch off before changing light bulbs; don't use a switch with wet hands because water can conduct electricity; don't touch live wires.
Slide 20	**Start making the roof** • Hand out the blunt pencils and collect in the sharp ones, so the pupils can't use the wrong ones. • Make sure the indent is made parallel with the corrugations so that the roof will bend properly. • The indented side should be at the top.
Slide 21	**Make the ends of the roof** • Collect in the nail scissors. • Hand out the large scissors and protractors.
Slide 23	**Finish the roof** • Make sure the lines are marked on the underside of the roof, across the corrugations. • It may be easier to work in pairs when gluing on the ends of the roof. Then one pupil can hold the roof in a folded position while the other glues on the ends.
Slide 24	**Decorate and populate your house** • If you have a transparent plastic sheet, it can be used to glaze the windows. • Any decorations you have can also be used on or in the houses for decoration or furnishing. • Pine cones with wiggly eyes can also be used for people.
Slide 25	**Plenary** • If you use a push-to-make switch for a lighting circuit, then as soon as you take your finger off the switch the light will go out. • If you use a slide switch for a doorbell then the person ringing the bell might just switch it on and leave it ringing, which would be really annoying!

Suggested Answers to the Worksheet

Label these electrical parts (components) used in your doorbell and lighting circuits: buzzer, push-to-make switch, bulb and bulb holder, slide switch, battery holder and cell, crocodile lead.

Crocodile lead

Battery holder and cell

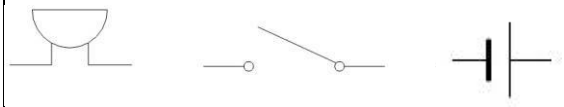
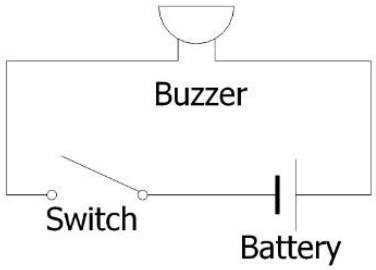
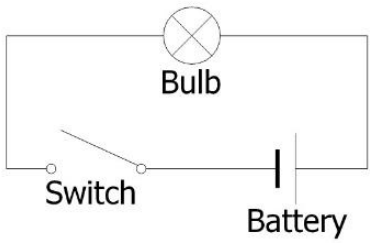


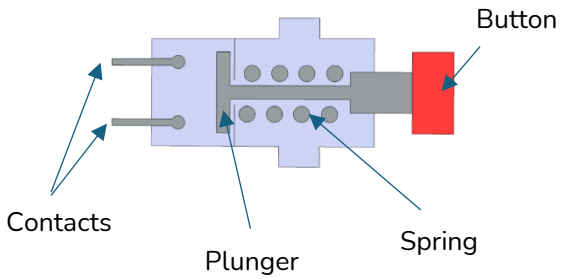
Slide switch

Push-to-make switch

Buzzer

Bulb and bulb holder

Draw your doorbell circuit using these circuit symbols and using lines to represent the wires. Label the components. 	
Draw your lighting circuit using these circuit symbols and using lines to represent the wires. Label the components. 	
Why did you need to attach the crocodile clips onto bare metal, not onto plastic insulation?	**Plastic is an insulator which prevents the current from passing. The bare metal ends are good conductors of electricity, so if I clip onto these the current can pass through.**
What will happen if you leave the circuit switched on for a long time?	**I will drain the battery.**
Does it matter which way round you connect your buzzer?	**Yes**
Does it matter which way round you connect your bulb?	**No**

Suggest a problem with using a push-to-make switch for a lighting circuit.	**If you use a push-to-make switch for a lighting circuit then as soon as you take your finger off the switch the light will go out.**
Suggest a problem with using a slide switch for a doorbell circuit.	**If you use a slide switch for a doorbell then the person ringing the bell might just switch it on and leave it ringing, which would be really annoying!**
Your battery only gives 1.5 Volts, whilst mains electricity used to wire a real (UK) house uses 240 Volts. Suggest some hazards of mains electricity.	**Some hazards of mains electricity include:** **Electric shocks** **Electrocution** **Electrical Fires**
Extension questions	
Explain how a push-to-make switch works  	**When you press the button, the plunger moves down and bridges the two contacts, completing the circuit.** **When you release the button, the spring pushes the plunger back up, so the two contacts are no longer connected, creating a gap in the circuit.**
Suggest some reasons why houses in cold climates usually have sloping roofs.	**Houses in many countries have sloping roofs, as it helps the rain to run off.** **In cold countries it is particularly important to have a sloping roof to help the snow slide off. A big build-up of snow is very heavy and can damage the roof.** **Many houses in hot, dry countries have flat roofs.**
What enables a pipe cleaner to retain its shape when you bend it?	**The metal (steel) core of the pipe cleaner is malleable, allowing the pipe cleaner to be bent easily and then retain its new shape.**