GENERATION SCIENCE

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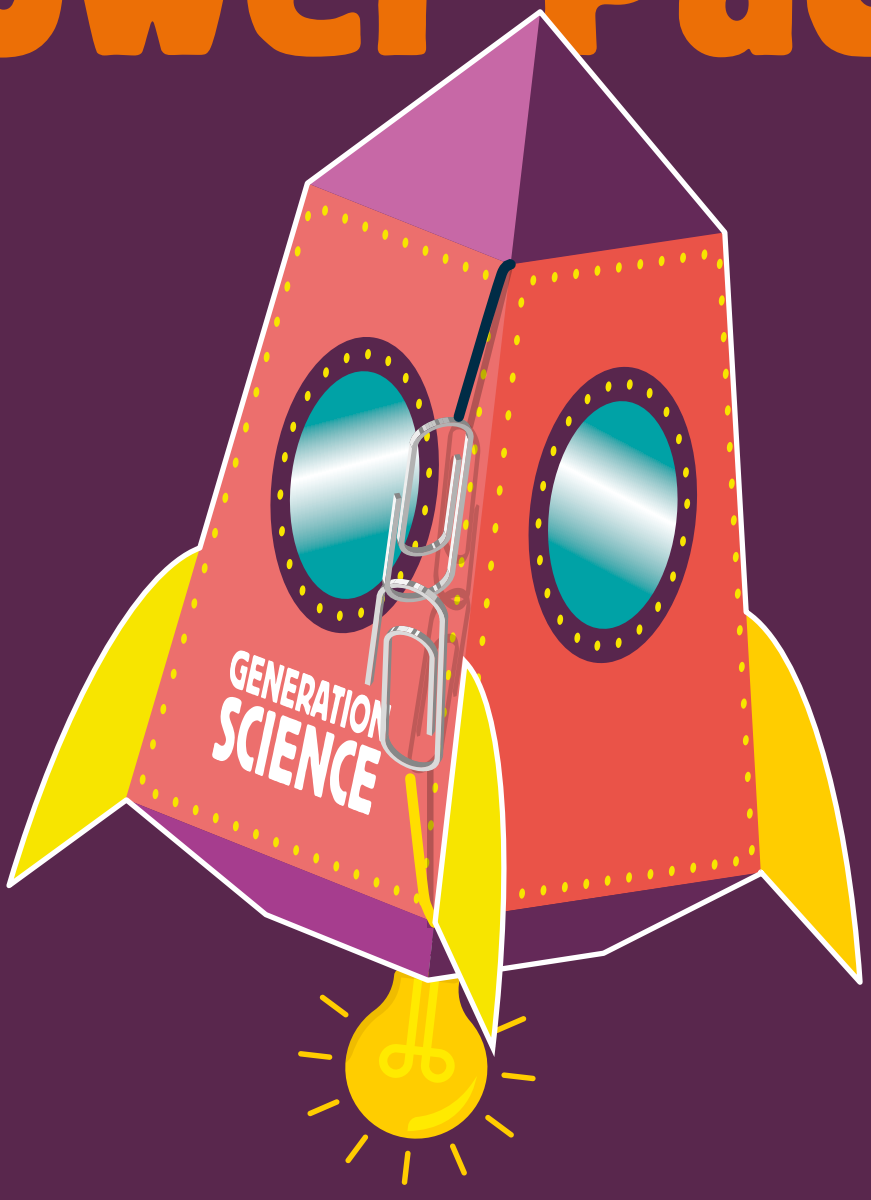
Power Pack



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CONTENTS

BOX CONTENTS

Please note, this kit contains materials which are suitable for children aged seven and above. All materials should be used under teacher guidance and supervision.

WORKSHOP KIT

1 x model wind turbine
1 x balloon pump
1 x screwdriver

WORKSHOP CONSUMABLES

8 x tubs of conductive dough
8 x buzzers
66 x AA batteries
16 x 4 AA battery holders
50 x LEDs
16 x dough circuit instructions
33 x 1 AA battery holders
33 x lightbulbs
33 x lightbulb holders
100 x paperclips
33 x rocket circuit diagrams
33 x rocket models
2 x sheets double-sided sticky pads
33 x balloons
33 x 50cm lengths of thread
33 x 15cm lengths of yellow wire

POWER PACK: BEFORE THE WORKSHOP

DETAILS

Target age group: P4–7

Minimum time required: 45–60 minutes

AT A GLANCE

Power Pack gives pupils a chance to get hands-on and explore electricity. They will undertake experiments and activities to discover more about how it is made and how it is used to power the world around us.

Students will:

- Explore what uses electricity around them.
- Investigate how they can create electricity.
- Discuss and explore what conductors and insulators are.
- Create circuits using conductive dough.
- Use wires and components to make a simple circuit.
- Learn how to read a circuit diagram.
- Investigate what renewable energy means.

SESSION OVERVIEW

Power Pack is a hands-on, practical workshop in which pupils explore and learn about the energy source we use to power many of the things around us – electricity. By asking questions about electrical items, exploring how they get their power and exploring conductors and insulators, how circuits are built and the future of renewable energy this workshop will provide pupils with a basic knowledge of the topic of electricity. The session is delivered via a series of pre-recorded videos, after which pupils will answer questions, complete experiments and carry out activities:

1. INTRODUCTION & WHAT USES ELECTRICITY?	**Video**	Introduction to the session and exploration of things that use electricity.
	Activity	Pupils warm-up and draw a timeline of their day depicting all the electrical items they use.
2. BALLOON EXPERIMENT	**Video**	Pupils explore electrical charge.
	Activity	Pupils use balloons to experiment with electrical charge.
3. WHAT IS ELECTRICITY?	**Video**	Pupils explore what electricity is.
4. WHAT IS A CIRCUIT?	**Video**	Pupils explore the basic concepts of a circuit and how electricity flows around it.
	Activity	Pupils build a squishy circuit using dough and electrical components.
5. WHAT CONDUCTS ELECTRICITY?	**Video**	Pupils are introduced to the concept of insulators and conductors.
	Activity	Pupils experiment with materials from around the classroom to identify conductors and insulators.
6. MAKING A CIRCUIT	**Video**	Pupils are instructed as to how to make their own electrical circuit.
	Activity	Pupils make their own electrical circuit using various components.
7. WHAT IS RENEWABLE ENERGY?	**Video**	Pupils explore renewable energy and how it can be created using wind turbines.
	Activity	Pupils discuss types of renewable energy and ideas about how to test a wind turbine.
8. WRAP-UP	**Video**	Summary of the session and discussion of what has been explored.
	Activity	Pupils discuss what they have learnt and what area of renewable energy they would like to explore next.

KEY LEARNING OUTCOMES

Pupils will be able to represent their current understanding as they:

- Recognise that electricity is a form of energy.
- Explain that lots of gadgets and components are powered by electricity.
- Explain that electricity is the flow of electrons through a material.
- Describe that a circuit it a continuous loop, with no breaks, that electricity flows round.
- Recognise that once the circuit is complete electrons flow around the loop sending electricity to anything within the circuit.
- Recognise some of the symbols used in a circuit diagram.
- Explain the difference between electrical conductors and insulators and be able to give examples of both.
- Understand what renewable energy means and describe types of renewable energy.

CURRICULUM LINKS

Power Pack complements the following experiences and outcomes:

SCN 1-04a: I am aware of different types of energy around me and can show their importance to everyday life and my survival.

SCN 1-09a: I can describe an electrical circuit as a continuous loop of conducting materials. I can combine simple components in a series circuit to make a game or model.

SCN 2-09a: I have a range of electrical components to help make a variety of circuits for differing purposes. I can represent my circuit using symbols and describe the transfer of energy around the circuit.

TEACHER BACKGROUND INFORMATION

Electricity

Electricity is a form of energy and it is produced from the flow of electrons through a material. All matter is made from tiny particles called atoms, and atoms are made from even smaller particles. In the centre of an atom is the nucleus and orbiting the nucleus are electrons.

Conductors and insulators

Not all materials allow electrons to move easily through them. Materials in which electricity can flow easily are known as conductors and they are made from atoms that have lots of free electrons which can easily move through them. Most metals, especially copper and silver, and water are good conductors. Materials which do not allow electricity to flow through them easily are called insulators. Their atomic structure means the electrons are tightly held to the atoms and cannot move around. Plastic, wood, stone and glass are good insulators.

Flow of electricity

Atoms contain positive and negative charges – electrons have a negative charge, protons in the nucleus are positive. Like with magnets, opposites attract and like repels. A flow of electrons needs a voltage pushing them. This can be created by a battery, which has a positive and a negative terminal. When a conducting wire connects them the electrons are pushed from the negative end of the battery around to the positive end.

Circuits

A closed loop of a conductor connected to a source of electricity is known as a circuit. If we put things (like light bulbs or fans) in this circuit then, as long as the loop has no breaks, electricity will flow and power that appliance. Switches are an easy way to create breaks in circuits to stop electricity flowing. Light switches are used to open and close circuits, either allowing or stopping the flow of electrons to switch a light on or off.

Renewable and non-renewable energy

A non-renewable resource is a natural resource that either cannot be reproduced or is consumed much faster than it can be created. Once we have used all the non-renewable resources on the planet they will be gone forever.

Electricity can be generated using non-renewable or renewable resources. Non-renewable resources include things like fossil fuels (e.g. coal and gas) and nuclear energy. Renewable resources are things like wind, wave and solar energy.

Many renewable resources work by using movement (like from the wind or water) to move a turbine. When the turbine moves it allows magnets to move past coils of wire, which is what generates the electricity. Non-renewable sources of electricity work by moving turbines in the same way but normally this movement is created by burning something that heats water and produces steam to move the turbine.

EQUIPMENT

For the class:

- 1 x balloon pump
- 1 x wind turbine model (either pre-built or built with the class as preferred)
- 1 x screwdriver
- 1 x large fan* (video 7 - non-essential)
- Paper and pens*

Video two - for each pair of pupils:

2x blown up balloons
1x piece of thread

Video four - for each pair of pupils:

1x lump of dough (half a tub)
1x 4AA battery holder
4x AA batteries
2x LEDs
1x dough circuit diagram
1x buzzer (shared with another pair)

Video six - for each pupil:

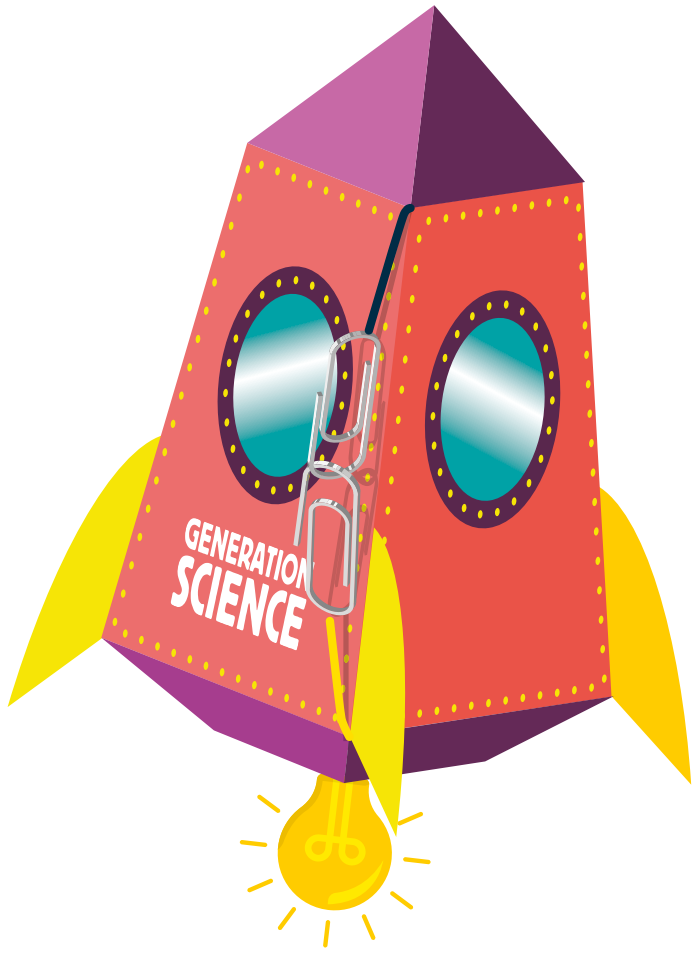
1x AA battery holder
1x AA battery (reuse from dough circuit)
1x lightbulb holder
1x lightbulb
1x yellow wire
2x paper clips
1x rocket instructions
1x rocket model
2x double-sided sticky pads
1x pair of scissors*
1x glue stick*

Please note all items marked * are not supplied in the *Generation Science* 2022 kit. If you are unable to source these, please get in touch with the *Generation Science* team. There is a full list of kit included in the box on p4 of this booklet.

PREPARATION

Before the workshop please:

- Read this welcome booklet fully to prepare yourself for the workshop.
- Check that you can access the videos via the link supplied and that you can play them on your computer.
- Check through the kit and familiarise yourself with the circuit-building guides.
- Inflate balloons for the class.
- Pre-build the model wind turbine using the instructions included (if you prefer, you can build this with the class).
- Decide on a method of distributing all of the activity materials to your pupils – we suggest using a tray at each table with enough materials for the group of pupils working there to select what they need.



POWER PACK: DURING THE WORKSHOP

LESSON PLAN

Details of the individual activities can be found below with diagrams where necessary. You can use this section to help you lead the class during the workshop.

SECTION	TEACHER GUIDANCE
Introduction & What Uses Electricity	1. Play Video 1: *Introduction & What uses Electricity?* 2. Encourage pupils to participate in the warm-up exercises when prompted. 3. At the end of the video, ensure pupils have paper and pencils and assist them to draw a timeline of their day showing all the electrical items they use (this can be done individually or in groups). Encourage them to think about all the things that are not obvious, like using the fridge, turning off lights in the classroom or using anything they charge. 4. Use the timelines to start a discussion of the number of electrical items they use in a day.
Balloon Experiment	1. Play Video 2: *Balloon Experiment* 2. At the end of the video, divide the class into pairs and distribute 2 balloons and a length of thread to each pair. 3. Using the instructions from the video encourage pupils to undertake the experiment. 4. Discuss as a class what happened when they moved their balloons together.
What is Electricity?	1. Play Video 3: *What is Electricity?* 2. At the end of the video, discuss and recap what electricity is with your pupils. Use the notes above to assist if needed.
What is a Circuit?	1. Play Video 4: *What is a Circuit?* 2. At the end of the video, make sure each pair of pupils have the materials listed in the equipment, video four, section. 3. Assist pupils to make a dough circuit following the instructions from the video and the instruction sheet.
What Conducts Electricity?	1. Play Video 5: *What Conducts Electricity?* 2. Encourage pupils to find things around the classroom to include in their dough circuit to test if the material is a conductor or an insulator. They could try coins, pens, glue sticks, scissors, rulers or pipe cleaners etc. 3. Discuss with your class what the materials that completed the circuit have in common. They should notice that metal items conduct electricity.
Making a Circuit	1. Play Video 6: *Making a Circuit* 2. At the end of the video, make sure each pupil has the materials listed in the equipment, video 7, section. 3. Assist pupils to make their rocket circuit following the instructions from the circuit diagram. They will need to cut out the rocket model as well. 4. Encourage pupils to pay attention to the circuit diagram and be careful to follow the colour of the wires on the diagram.
What is Renewable Energy?	1. Play Video 7: *What is Renewable Energy?* 2. Pause the video when instructed and discuss with your class different types of renewable energy they might have heard of. 3. Press play again when ready. 4. At the end of the video, assist pupils to form groups and encourage them to write down all the ways they can think of to get the wind turbine blades to turn (e.g. try running with the turbine, use a large fan, blow on the turbine, spin the turbine with their hands, hold the turbine out the window etc). 5. As a class discuss each group's idea and test how well it would work.
Wrap-Up	1. Play Video 8: *Wrap-up* 2. At the end of the video, discuss with your pupils what they have explored in the workshop and which areas of renewable energy they would like to explore next.

POWER PACK: AFTER THE WORKSHOP

LESSON SUPPORT

This section gives you a list of links to videos and websites that you can use to talk more about this topic. We have suggested whether each link could be useful to watch as a class, for young people to do at home, or as an activity for you prepare. Finally, we have suggested two follow up activities you can do with classroom resources to expand on the learning outcomes.

FOLLOW-UP IDEAS

At home

Encourage a discussion at home about where their electricity comes from. *#AtHome*

Design and make

Create mini wind turbines in the classroom using basic craft materials. See Follow-Up Activity 1. *#Activity*

Investigate

Use maps of Scotland to find out where wind farms are situated and discuss what makes a good wind farm location. *#Activity #AtHome*

Research

Undertake a research project to explore how solar panels and wave power work. *#Activity*

USEFUL LINKS

BBC Bitesize: What is Electricity? *#WatchTogether #AtHome*
https://www.bbc.co.uk/bitesize/topics/z2882hv/articles/zcwnv9q

DK Find Out: How is Electricity Generated? *#AtHome*
https://www.dkfindout.com/uk/science/electricity/generating-electricity/

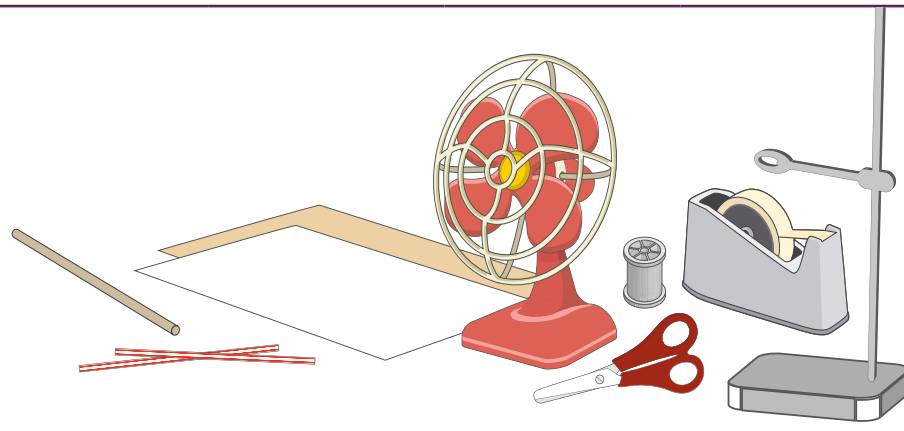
DK Find Out: Conductors and Insulators. *#AtHome*
https://www.dkfindout.com/uk/science/electricity/conductors-and-insulators/

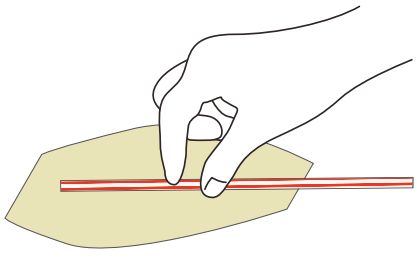
FOLLOW UP ACTIVITY 1

BUILD A WIND TURBINE

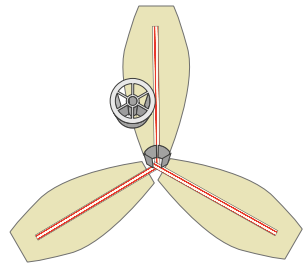
You will need:

- Sellotape
- Scissors
- Empty cotton reels
- Paper straws
- Cardboard
- Paper
- A stand to test the wind turbines on – a clamp stand with a stick which fits easily inside the cotton reels is fine
- Desk fan

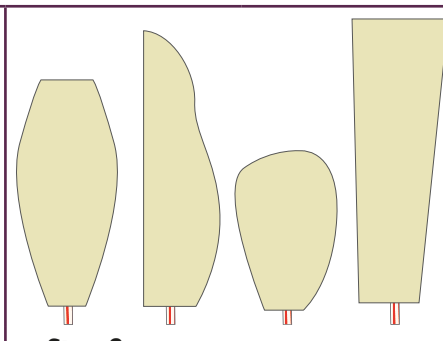




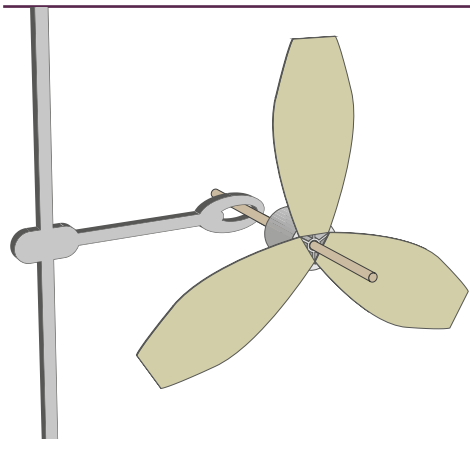
Step 1:
Using the materials provided build a set of wind turbine blades.



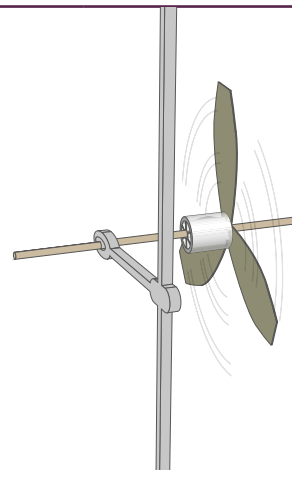
Step 2:
Make sure your blades can be attached to a cotton reel without blocking the hole at the back.

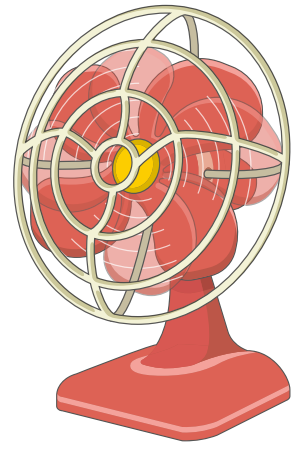


Step 3:
Your design can be any shape or size, but be careful it's not too flimsy; you don't want it to fall apart during testing!



Step 4:
Place your wind turbine on the class stand so it can turn freely.





Step 5:
Turn on the fan and test your wind turbine.

Extension

Which designs worked best and why? Why did some designs work less well? How are these different to the real world?

Explanation

Wind turbines are used to convert kinetic energy from the wind into electricity. The wind can move turbine blades because moving air has a force. If an object is placed in the way of moving air, the air will exert a force on the object. If the object is free to move in a direction which is less than 90˚ to the moving air it will accelerate in that direction.

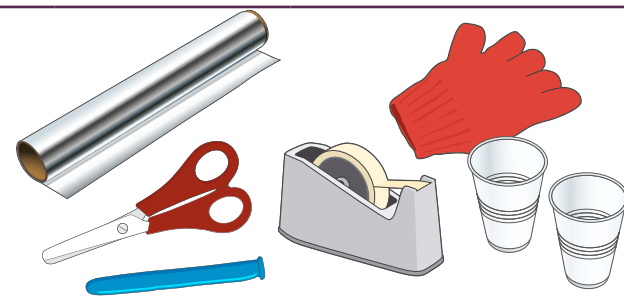
The simplest design of a turbine blade is called an angled sail. The moving air hitting the blade at an angle pushes the blade around the turbine's axis. Today most turbines employ more sophisticated blade designs in the shape of an aeroplane wing (this shape is called an aerofoil). These blades are pulled around due to the effects of lift which is generated as air flows over the blades.

FOLLOW UP ACTIVITY 2

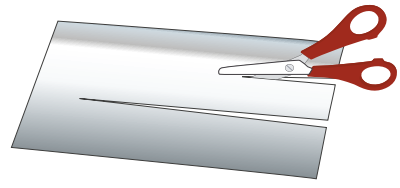
SUPER SPARKER

You will need:

- 2 disposable cups
- Tin foil
- Scissors
- Sellotape
- Balloon (a long balloon is easiest)
- Piece of woollen material (e.g. a glove, scarf or old jumper)

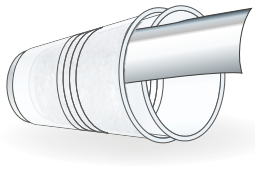


Step 1:
Cut a rectangular piece of tin foil large enough to wrap around one of the cups. Wrap it around the outside, leaving 2cm around the top of the cup uncovered.



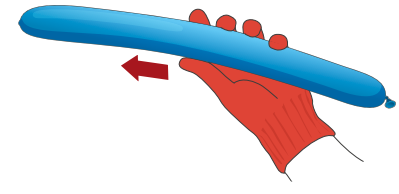
Step 2:
Cut another thin rectangle of tin foil approximately 2cm by 15cm.

Step 3:
Place the thin rectangle of tin foil along the seam of the wrapped tin foil so that at least half of the strip sticks above the cup and secure it with some sellotape.

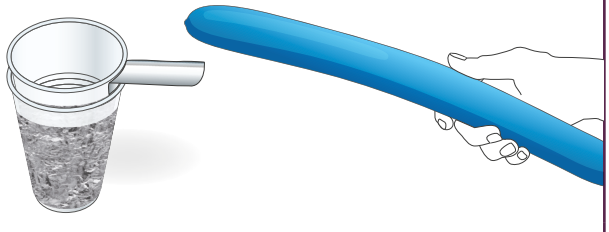


Step 4:
Place this covered cup inside the other cup.

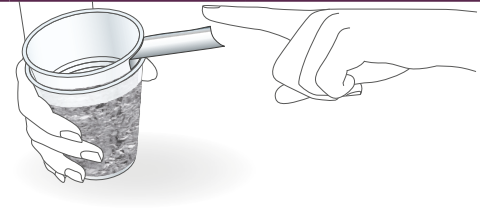
Step 5:
Wrap the second cup with tin foil, ensuring this doesn't touch the tin foil on the inside or the strip sticking out the top.



Step 6:
Rub the balloon a few times with the piece of wool (rubbing only in one direction works best).



Step 7:
Touch the balloon to the strip of tinfoil. Listen carefully. Can you hear anything? Repeat steps six and seven at least five times (the more you repeat the bigger the spark will be) being careful not to touch the strip with anything but the balloon.



Step 8:
Pick up the cup with one hand, holding the tinfoil on the outside. With the other hand, carefully touch the end of the tinfoil strip with a finger... what happens?
Try it again in the dark. Can you see what happens?

Extension
Instead of using your own finger, hold hands with a friend and get them to touch the strip while you hold the cup. Did you feel anything? How many people does it work with?

Explanation

This piece of equipment is a called Leyden jar, invented in 1745. It preceded the modern day capacitor – a device used for storing electricity.

When the balloon is rubbed with the wool, electric charges (electrons) are transferred to the surface of the balloon. When there is a build-up of charge on an object and it comes into contact with a less charged object, electrons will move towards this object to even out the distribution.

So the extra electrons on the balloon transfer to the tin foil, spreading evenly across it. Repeat touches charge up the tin foil with electrons.

When you hold the outer layer of tin foil and bring your finger towards the charged strip, your body completes a circuit and you get a small static shock. In the dark you can sometimes see the movement of charge between your finger and the tin foil as a small blue spark.