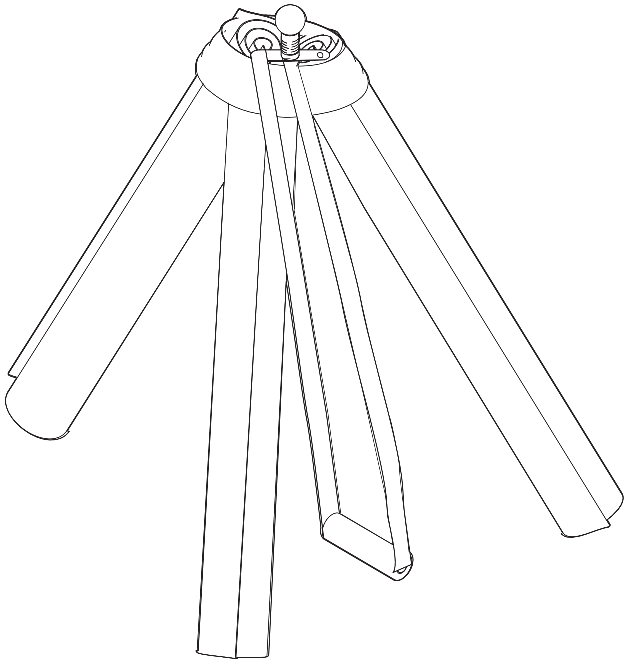


LIGHTHOUSE CHALLENGE WORKSHEET

GETTING STARTED

5-10m

This challenge is a great way of learning about the engineering techniques that are used when constructing a lighthouse. It will also encourage you to explore the science behind creating the all-important light source found at the top of these lifesaving structures.

We also want you to explore how to reuse and recycle materials found around the home that would have otherwise been thrown away.

You'll have to consider the strengths and weaknesses of the materials that you have before designing and building your lighthouse.

Make sure you take into consideration which shapes will provide you with the height and stability that you'll need to make this challenge a success.

VOCABULARY

Lighthouse - A tower or other structure containing a beacon light to warn or guide ships at sea.

Free-standing - A structure that remains upright on its own and is not attached to, or supported by, another structure.

Stability - The ability to remain steady, and unlikely to move or change even under an external force.

Structural - Relating to, or forming part of, the structure of a building or other item.

Beacon - A fire or light set up in a high or prominent position as a warning signal.

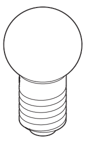
Conductivity - The degree to which a specified material conducts electricity.

Electrical Insulator - A material that does not allow the flow of electricity through it.

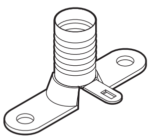
Electrons - A negatively charged subatomic particle. It can be free or bound to the nucleus of an atom.

Circuit - A closed path that allows electricity to flow from one point to another.

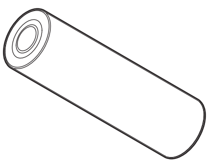
YOU WILL NEED



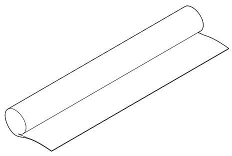
Bulb
1



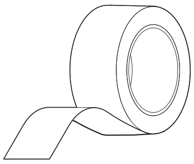
Bulb Holder
1



AA Battery
1



Aluminium Foil
5 metres



Masking Tape
5 metres

Newspaper

WARM-UP ACTIVITIES

A

5-10m

Using the suggested kit list or any materials you are able to reuse or recycle, experiment with different shapes and materials to see which will provide your structure with the most stability.

Don't forget to:

1. **Be creative -** draw some inspiration from the structures you have seen.
2. **Be hands-on -** learn by doing.
3. **Trial and error -** remember that engineering is a process, perseverance is essential, and learn from your mistakes.

B

10-15m

Using online resources, research the design of the modern lighthouse.

You have 10 minutes to answer the following questions:

1. Why are lighthouses cylindrical?
2. Why are lighthouses painted in different colours and patterns?
3. What different methods have been used to power the beacon at the top of the lighthouse?
4. Are lighthouses still needed?

MAIN CHALLENGE

10-40m

Working in teams or individually, you are going to design and build a working lighthouse structure.

Before starting construction, you will design your lighthouse and decide what materials will best suit your needs. We encourage you to use the suggested kit list, but also to reuse and recycle any materials you may have at home.

Don't forget to use the information you learnt during your warm-up activities, as this will help you in your design phase.

The lighthouse must stand unaided for 10 seconds, with a working light at the top.

WARNING - Do not leave your battery attached to the aluminum foil for longer than 10 seconds as it will overheat.

If you need more information about building the circuit for your light, please refer to the additional educational content that can be found after the build instructions.

Once you have finished, you can complete a quick quiz to test your knowledge. Good luck!

DID YOU KNOW?

Before more permanent structures were built, sailors were guided by fires on hilltops and beaches. The first example of the traditional lighthouse structure was the Pharos of Alexandria, built between 280-247 BC.

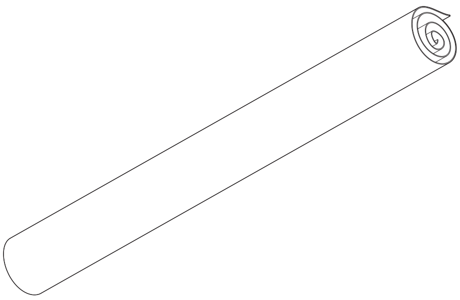
BUILDING THE LIGHTHOUSE

There are many ways of building a lighthouse with the materials you have to hand, but if you're unsure where to start, here are the steps that we followed to build ours:

A

Take two sheets of newspaper, roll them into a tube and secure with masking tape. If you don't have a newspaper to hand, two sheets of scrap A4 paper stuck together will also work.

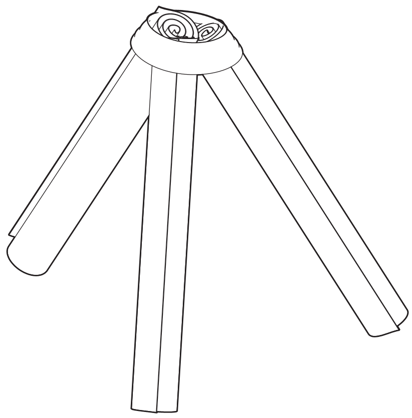
Repeat this step two more times, so that you have three separate tubes.



B

Using the three tubes, create a tripod structure and secure at the top with masking tape.

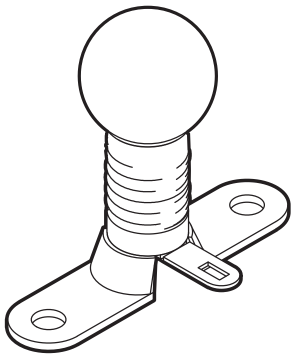
You should now have something that looks like the image below.



C

Take your lightbulb and screw this into your lightbulb holder.

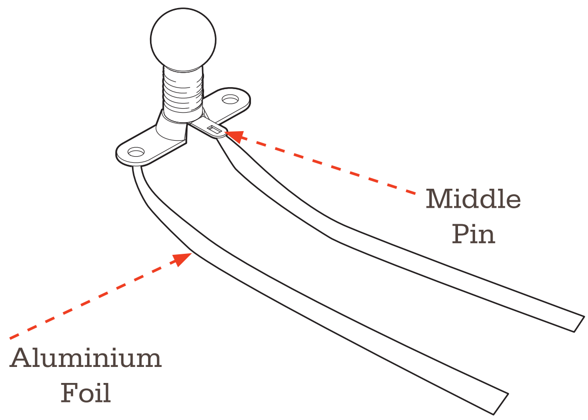
Ensure this is secure enough to remain in place, but be careful to not do it too tight.



D

Next, tear two pieces of aluminium foil about 20cm longer than your tripod. These will be used to conduct the electricity between the lightbulb and the battery.

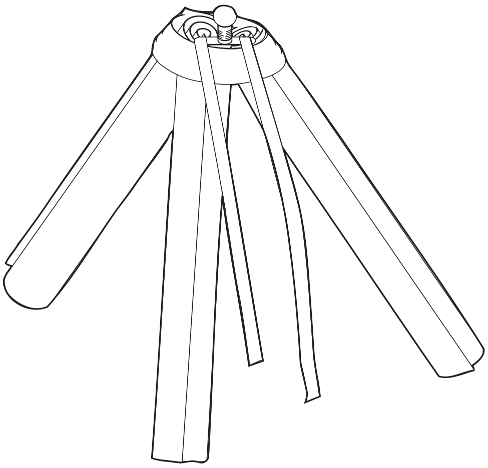
Twist one end of each piece of aluminium foil, and loop one through the hole in the middle of the bulb holder, and the other through one of the holes on the side of the bulb holder.



E

Place the lightbulb on the top of your tripod shape; make sure it is stable enough and won't fall off.

The aluminium foil strips should reach the base of your build with about 10cm to spare.

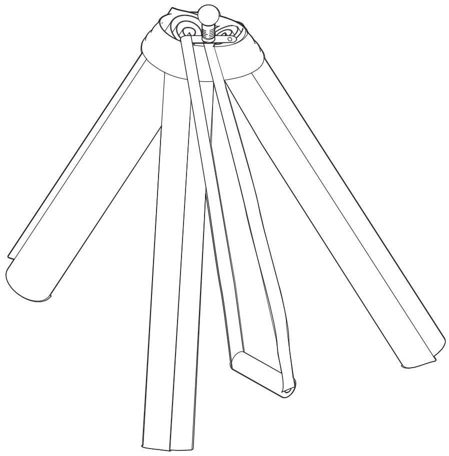


F

The final step is to wrap one piece of aluminium foil around the positive end of your battery, and the other piece of aluminum foil around the negative end of your battery.

Make sure the two pieces of aluminium foil don't touch each other as this will cause a short circuit.

WARNING - Do not leave your battery attached to the aluminium foil for longer than 10 seconds as there is a chance it will overheat.



LIGHTHOUSE CHALLENGE CONDUCTIVITY

10-15m

KS1/2 PROOF OF CONCEPT

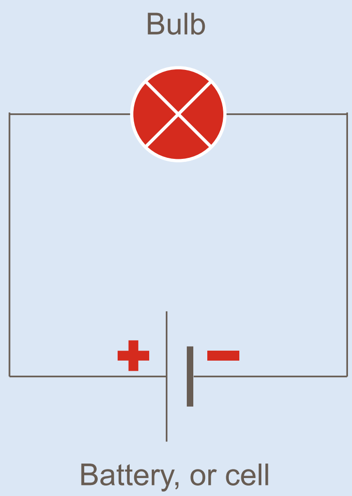
Conductivity is how good a material is at carrying an electrical current. Lots of metals are excellent conductors of electricity and that is why electrical components invariably contain metal parts. Think about plugs, lightbulbs and wires: they all have metal components that help electricity transfer and follow a circuit. In our case, we've used aluminium foil to help light up your bulb.

When we connect the aluminium foil to the battery, electricity is allowed to flow to the bulb which is turned into heat and light energy.

The opposite of a conductor is an insulator; these materials, such as plastic and wood, do not allow for any flow of electricity through them.

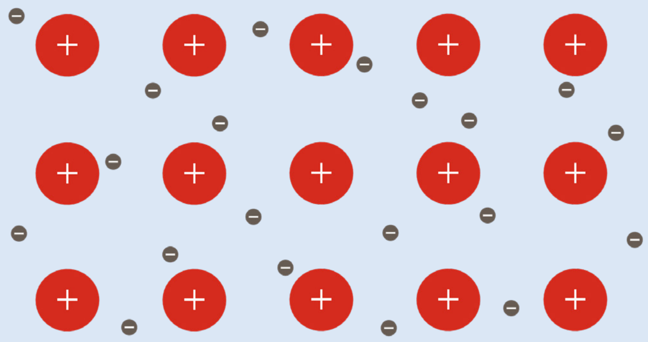
Electricity also needs a complete circuit in order to flow. If there is a break in the circuit, the flow stops and nothing will work. That is why it was so important to complete a full loop between your battery, or cell, and your lightbulb using the aluminium foil.

An example of this simple complete circuit can be seen in the image opposite.



KS3/4 DEEPER LEARNING

A metal's conductivity depends on the free movement of electrons within its structure. Electrons are negatively charged particles that are responsible for the transfer of electrical energy.



The structure of metals allows electrons to flow freely in the space between atoms. This 'sea of electrons' as seen in the image above, allows for the flow of charge through the material.

This flow of electrons through a circuit is called the current, and the electrical pressure available to push the current is called the voltage. Voltage is also known as Potential Difference because it can be described as the difference in charge between two points. You can think about this like a water slide; the flow of water is the current, and the difference in height between each end of the slide is the voltage.

The opposition to the flow of current in a circuit is the resistance, and this is measured in Ohms (Ω). The equations below describe the relationship between these properties, as well as how to calculate the electrical power supplied.

$$V = IR \qquad P = IV$$

Where V is the potential difference, or voltage, I is the current, R is resistance and P is power.

V = IR (also called Ohm's Law) tells us that you can increase the current in a circuit by increasing the voltage or decreasing the resistance.

We can also see from P = IV how this would increase the power to the bulb and therefore how brightly it will glow.

Different materials have different levels of conductivity. If we know that copper is more conductive (or less resistant) than aluminium, we would expect more current to flow through the circuit resulting in our bulb getting brighter.

QUIZ

15-20m

What is a conductor?

....

....

Why are metals conductive?

....

....

What is the purpose of a lighthouse?

....

....

What is an electrcial insulator?

....

....

Why are most lighthouses cylindrical in shape?

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....

QUIZ

When was the first example of a lighthouse built?

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....

What is an electron?

....

....

What was used to warn sailors before the lighthouse was built?

....

....

What happens if an electrical circuit isn't closed?

....

....

What will happen to the light if we increase the current?

....

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