

This is a follow-up resource with some simple activities you might like to run with the students after their visit to Lab in a Lorry. The activities are based on renewable energy and can be adapted to fit the particular level or age of the students.

Looking at Hydroelectricity

Make a water wheel

Equipment:
Plastic Bottles
Straws (non bendy)
Plastic Spoons
Plastic Spoons with the handles cut off
Plasticine
CDs
Magnets
Scissors
Rulers
Stopwatches
Multimeters
Wire
Steel Nuts

In this activity the students make their own water wheel and depending on ability can investigate a number of different things.

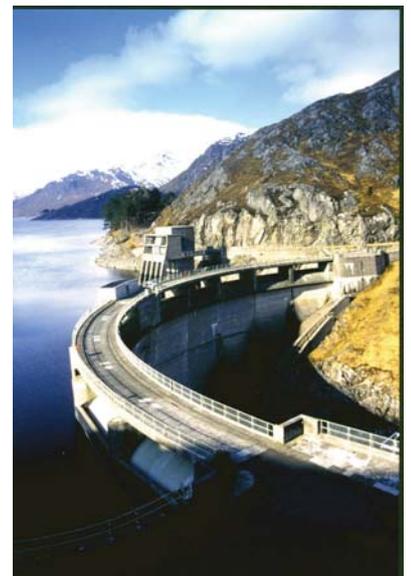
A simple investigation might involve changing the number or length of the spoons. This could be done individually or to save time split the class into groups with half the class investigating length and the other half the number of spoons. There is a worksheet explaining how to make the water wheel (page 2) and then a further 2 sheets (3, 3a), one for those investigating the number of spoons and the other for those varying the length. After completing the investigation the whole class can then complete page 4, using the results from the 2 experiments.

For higher ability students there's an extension sheet with the option of making a simple dynamo and connecting it to a multimeter to measure the current/voltage produced.

The water wheel they will be making is called a Pelton Wheel. There are many different types of water wheel, each designed for a specific purpose. A Pelton wheel is turned by the momentum of running water and works best with a high pressure, narrow jet of water. For the investigation the students can use the water from the lab taps to turn their wheels.

By investigating different lengths of spoons the students should discover that a small wheel will turn faster but has less torque. This means it is less effective when under load.

Generally, adding more spoons makes the wheel more effective, until the optimum number is reached. Adding further spoons increases weight and has an overall negative effect.



Monar HEP Station, Scotland

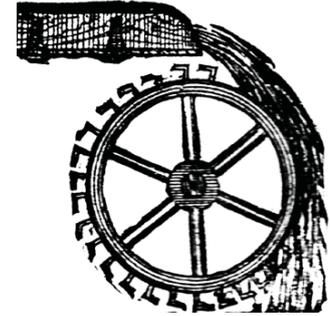


Pelton Wheel

Water wheels were invented by the Greeks over 2000 years ago.

The first water wheels were used to lift objects and of course for milling (grinding up) grains to make flour for bread.

Modern versions of water wheels are used to generate electricity in hydro-electric power stations.



Where do they normally build hydro-electric power stations?

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Why is this a good place?

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Investigating Water Wheels

In this activity you are going to make your very own water wheel and use it in an investigation.

List 3 things which will affect how well the wheel turns.

1)2)3)

Making the Water Wheel

- Take the plasticine, make it into a ball and then squash it so it looks like a fat biscuit. This is the centre of your wheel.
- Stick the spoons into the side of the plasticine at different places, but make sure they all face the same way. Try to space them out evenly. On a real wheel these are shaped like cups
- Use the scissors to punch a hole through the side of the plastic bottle. The hole should be about 1/3 of the way down from the top and big enough to push the straw through easily. Take care not to slip when you do this.
- Now make another hole on the opposite side of the bottle, in line with the first one. Pour water into the bottle until it's about 1/3 full, this will prevent the wheel from falling over.
- Next push one end of the straw into the centre of the plasticine and the other through the bottle. It should now look a bit like the one on the right.

Equipment List

An empty 2 litre Bottle
A straw
Some Plasticine
Sharp Scissors
Plastic Spoons



Testing the wheel

- Place your water wheel into the sink and turn on the tap. Move the wheel into position under the running water and it should start to spin. You may need to adjust some of the spoons so that the water hits all of them.



Using the wheel

We want to use our wheel like the Greeks, to lift up objects.

- Tie the nut onto the end of the string and attach the other end to the straw using the sticky tape.
- Drape the string over the side of the Lab bench and let it hang loose.
- Now turn on the tap. The wheel should turn, wind up the string and raise the weight.

Once you have this working properly start it off again but this time use the stopwatch to measure the time taken for it to wind up all the way.

Remember to repeat the experiment a few times and record your results in a table

Try changing the number of spoons, think about the water - what do you need to keep constant to make it a fair test?

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Does changing the number of spoons make a difference to the time taken to wind up the string?

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What does this tell you about the speed at which the wheel is turning?

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Describe the relationship between the speed and the number of spoons

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Why don't manufacturers make wheels with hundreds of cups (spoons)?

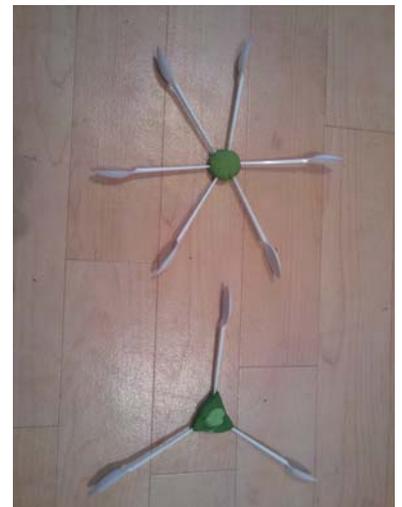
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Equipment List

String / Cotton
Sticky Tape
Nut or similar weight
Stop Watch



Testing the wheel

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Using the wheel

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Once you have this working properly start it off again but this time use the stopwatch to measure the time taken for it to wind up all the way.

Remember to repeat the experiment a few times and record your results in a table

Try changing the spoons for ones with a shorter handle, think about the water - what do you need to keep constant to make it a fair test?

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Does changing the spoons make a difference to the time taken to wind up the string?

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What does this tell you about the speed at which the wheel is turning?

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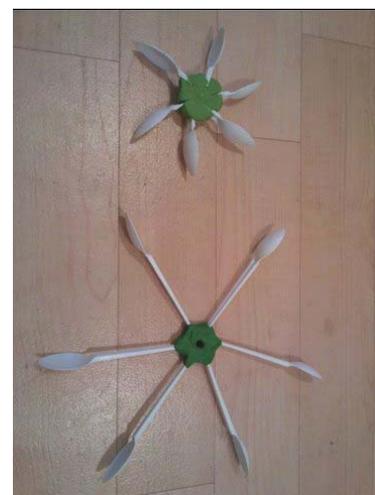
Describe the relationship between the speed and the length of the spoons

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Equipment List

String / Cotton
Sticky Tape
Nut or similar weight
Stop Watch



Which combination of number and length would make the *fastest* wheel?

Circle your answer.

- a) a few spoons with short handles
- b) lots of spoons with long handles
- c) lots of spoons with short handles
- d) a few spoons with long handles

Extension Problem:

Why do we use large wheels with many cups? (option (b) above)
(Hint - think about pushing open a door - where is it easiest to push? By the hinge? or By the handle? Why?)

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How could you test this using your equipment?

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Full size Pelton wheel water turbine at an Hydroelectric powerstation.

Extension Work

Using the wheel to generate electricity

Wind Turbines and Water Wheels are used to generate electricity.

Generating electricity by this means relies on something called Electromagnetic Induction.

- Connect the 2 ends of a coil of wire to a multimeter and insert a magnet into the centre of the coil.

What do you notice?.....

When a magnet is close to a coil of wire the magnetic field exerts a force on the charged particles in the wire. This creates a voltage in the wire and electricity will flow. We call this Electromagnetic Induction and it is the basic principle behind electric motors and electrical generators.

To produce a small current using your water wheel you will need a coil of wire, an old CD, some plasticine, sticky tape and a few magnets.

- Attach the coil to your bottle using the sticky tape - see diagram
- Fix the magnets to the CD by placing them on opposite sides, then attach the CD to your straw using the plasticine.
- Make sure the magnets are positioned on the CD so that they will be close to the coil as it spins and then connect the ends of the wire to a multimeter.
- Place the wheel into position and turn on the tap. How many volts / amps is your wheel producing?

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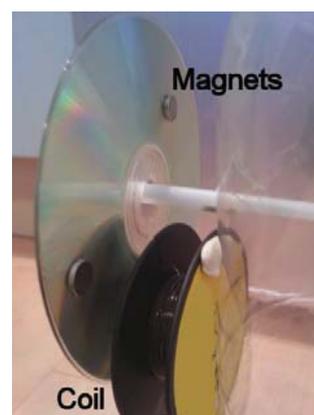
Congratulations - you have successfully converted the energy from running water into useful electrical energy.

- Draw an "energy chain" diagram for this process

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Equipment List

Your water wheel
Multimeter
2m of wire
CD
Magnets
Plasticine
Sticky tape



- Research how hydroelectric and wind power are literally changing the face of Scotland and then write a poem about it.
- How might these alternative energy resources change our lives in the future? Draw a poster showing what life is like now and what it could be like in the future.

Planet Earth

First	Second	Third	Fourth
<p>I am aware of different types of energy around me and can show their importance to everyday life and my survival. SCN 1-04a</p>	<p>I can investigate the use and development of renewable and sustainable energy to gain an awareness of their growing importance in Scotland or beyond. TCH 2-02b</p>	<p>By investigating renewable energy sources and taking part in practical activities to harness them, I can discuss their benefits and potential problems. SCN 3-04b</p>	<p>By contributing to an investigation on different ways of meeting society's energy needs, I can express an informed view on the risks and benefits of different energy sources, including those produced from plants. SCN 4-04a</p>

Topical Science

Second	Third	Fourth
<p>Through research and discussion I have an appreciation of the contribution that individuals are making to scientific discovery and invention and the impact this has made on society. SCN 2-20a</p>	<p>I have collaborated with others to find and present information on how scientists from Scotland and beyond have contributed to innovative research and development. SCN 3-20a</p>	<p>I have researched new developments in science and can explain how their current or future applications might impact on modern life. SCN 4-20a</p>