

River Ness Hydro Project - Class Teacher Tips

Learning intentions

- To understand what renewable energy is and why it is important.
- To test different variables to determine how we can produce the most energy.

Activity 1 — Discussion

Discuss as a class the following points

1. What is renewable energy?

Renewable energy is any energy we use that comes from renewable, natural sources.

Renewable means that it's naturally replenished, so can't run out.

- Can you give some examples of renewable energy?
 - Solar
 - Wind
 - Hydro
 - Tidal
 - Biomass
 - Geothermic
- Why do we want to use renewable energy sources to produce electricity?
 - It is better for the environment.
 - It won't run out like fossil fuels.
 - It produces much less (sometimes no) pollution.
- What is hydro power?

A form of energy that harnesses the power of water in motion—such as water flowing over a waterfall—to generate electricity.

Hydropower plants capture the energy of falling water to generate electricity. A turbine converts the kinetic energy of falling water into mechanical energy. Then a generator converts the mechanical energy from the turbine into electrical energy.
- What are different types of hydro power?
 - Dam

A dam is a structure built across a stream or river to hold water back. Dams can be used to store water, control flooding, and generate electricity.

A conventional dam holds water in a man-made lake, or reservoir, behind it. When water is released through the dam, it spins a turbine connected to a generator that produces electricity. The water returns to the river on the downstream side of the dam.
 - Archimedes Screw

An Archimedes Screw is basically an inclined plane and cylinder.

It can be used in 2 ways:

 1. To lift water from a lower to higher level.

For example draining water out of mines or the hull of ships, pumping water from rivers/lakes to irrigate (water) fields or for moving grain inside a combine harvester.

An Archimedes' screw is a simple machine (a type of pump) which lifts water up when it is turned. The lowest portion of the screw just dips into the water, and as it is turned a small quantity of water is scooped up into the tube. As the screw turns, the water slides along the tube until the water comes out the top of the tube.

2. To produce electrical energy.

Water flows from a higher level to a lower level when we use an Archimedes Screw to produce electrical energy. As water flows from the higher level to the lower level it will pass through spiral blades causing the screw to turn. The energy will then be converted into electricity using a generator.

- Watch these videos to learn about some careers within the renewable energy sector.
 - o [James at the European Marine Energy Centre \(EMEC\)](#)
 - o [Jerry at the European Marine Energy Centre](#)
 - o [James at SSE](#)

Activity 2 — Test a Hydro Turbine.

In groups, make your own hydro turbine and test different variable to see if you can produce more energy.

- ❖ Pupils could do this activity in pairs or groups of 3 or 4 pupils.

Equipment

- Plastic bottle (with a hole in the bottom)
- Wooden dowel/skewer
- String
- Plasticine
- Laminated card
- Tape
- Scissors
- Stopwatch



- ❖ You can just use card that is not laminated but pupils will need to cover it in clingfilm or tin foil to make it waterproof before attaching to the bottle.
- ❖ You will need to make the hole in the bottom of the bottles before giving them to the pupils as they will not manage this. The easiest and quickest way to do this is to use an electric drill.

Method

1. Cut out 4 rectangles the same size from the laminated card. Each rectangle should be about $\frac{1}{3}$ the height of the bottle. These will be the paddles of the turbine.

❖ If using card, wrap the paddles in clingfilm/tinfoil to make them waterproof.



2. Mark on the bottle where the paddles will go. Make sure they are evenly spaced out.



3. Cut along the marks you have made on the bottle where the paddles will go.



4. Fold one edge of your paddles about 1cm from the end.

❖ This helps the paddles stay in place better but you can miss this step out.



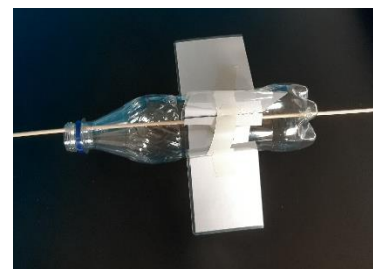
5. Insert the folded edge of the paddles into the slits you have made on the bottle.



6. Tape the paddles to the bottle.



- Put the dowel/skewer through the hole and then top of the bottle.



- Tie one end of your string to the top of the bottle and add a small amount of plasticine to the other end of the string.



- Hold your turbine under running water and time how long it takes for the string to wind up.
 - You could do this over a sink and use water from the tap to spin the turbine or fill a jug with water and hold the turbine over a large tray to catch the water as you pour it on to the turbine.
- Fill in the table below.

Attempt 1 (s)	Attempt 2 (s)	Attempt 3 (s)	Average (s)

The faster the string is wound up is more energy is being produced by the water.

Experiment

- If you do not have time to do this part of the activity then you could ask each group to build their own hydro turbine but with 1 variable different for each group. For example, if you decide you want to change the number of paddles then 1 group could make a hydro turbine with 3 paddles, another with 4 paddles, another with 5 paddles etc. and then compare them.

Change 1 variable on your hydro turbines to see what change will produce more energy.

- Make a new turbine, changing 1 variable.
Here are some suggestions of what you could change.
 - Number of paddles
 - Size of paddles
 - Shape of paddles
 - Height the water is falling from

Use the table below to help you.

The variable I will change is:	Number of paddles
The variables I will keep the same are: (everything else)	The length of string
	The size of bottle
	Size of paddles
	Shape of paddles
	Height the water is falling from

- Make a prediction about what you think will happen.

I think the hydro turbine with more paddles will produce more energy.

- Test your new turbine and fill in the table below.

Attempt 1 (s)	Attempt 2 (s)	Attempt 3 (s)	Average (s)

- Compare your results from both of your turbines and make a conclusion about which produces the most energy.

The hydro turbine with 4 paddles produced more energy than the one with 6 paddles. We know this as the string wound up faster.

Discussion

- What is a variable?
A Variable is something that we can change.
- Why do we only change 1 variable?
So we know what effect that variable has.
If we change more than 1 variable and the string winds up quicker (meaning more energy is being produced) we do not know which variable caused it to happen.
- Why did we test each turbine 3 times and take an average?
It makes our results more reliable.
It also highlights if any of our results are wrong, for example if we get 1 result that is very different from the other 2 then we have probably done something wrong when running that test.
- Compare the whole classes results and see if you can work out what the best turbine you could make would be, e.g. which size, shape and number of paddles generates the most energy.
 - If you have time you could build it and test it.
- If you were to repeat this experiment how would you make it better?
 - Make sure our measurements are accurate when building our turbines.
 - Test each turbine more than 3 times.

- Make sure we pour the water at the same speed.
 - Have the same person pouring the water each time.
 - Have the same person timing how long the string takes to wind up each time.
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Activity 3 - River Ness Project Quiz

Watch [this video](#) about the River Ness project and then try out [this quiz](#) on Kahoot.

Curriculum for Excellence Links

- 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**
- I can analyze how lifestyles can impact on the environment and Earth's resources and can make suggestions about how to live in a more sustainable way. **TCH 2-06a**
- I can make suggestions as to how individuals and organisations may use technologies to support sustainability and reduce the impact on our environment. **TCH 2-07a**
- I can extend and enhance my design skills to solve problems and can construct models. **TCH 2-09a**
- Through exploring non-renewable energy sources, I can describe how they are used in Scotland today and express an informed view on the implications for their future use. **SCN 2-04b**