genesis school-gen | STEM PLD
presented by
nanogirl

Hydro Power
Water Wheel

Summary:

This resource supports your teaching around the topic of **renewable energy** and **hydroelectric power.** It contains an activity suitable for Years 5-8.

Your students will:

- **UNDERSTAND:** Renewable energy is important for sustainability. Hydroelectric power is part of New Zealand's journey towards sustainable clean energy.
- **KNOW:** Hydroelectric power means creating electricity from moving water. This is accomplished by turbines placed in bodies of moving water, which spin and produce electricity.
- **DO:** Build a model of a water turbine, and use it to investigate how hydropower plants work.

Curriculum Links:

Learning Areas	Achievement Objectives	Levels	Years
Science **Nature of Science:** Investigating in Science	Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations.		5-8
Physical World: Physical Inquiry and Physics concepts	Explore, describe, and represent patterns and trends for everyday examples of physical phenomena, such as movement, forces, electricity and magnetism, light, sound, waves, and heat.	3-4	5-8
Planet Earth and Beyond: Earth Systems	Explore and describe natural features and resources. Appreciate that water, air, rocks and soil, and life forms make up our planet and recognise that these are also Earth's resources.	1-2 3-4	5-8 5-8
Technology **Nature of Technology:** Characteristics of Technology	Understand how society and environments impact on and are influenced by technology in historical and contemporary contexts and that technological knowledge is validated by successful function.		5-8

Understand

Earth's resources, including water, can be harnessed to use as sources of renewable energy. Water (***wai***) is a taonga with huge importance to people everywhere. Water affects so many aspects of our daily lives, from drinking water, as a source of kaimoana, supporting agriculture, to extreme weather events.

Renewable energy (***pūngao whakahou***) generation is one way that New Zealand is transitioning to a cleaner, more sustainable energy industry. Increasing the amount of renewable energy that we can make often relies on new technology.

Ka ora te wai, ka ora te whenua—If the water is healthy, the land thrives.

Know

Hydroelectric power is very important in New Zealand. About 60% of our total electricity comes from hydroelectric sources. Hydroelectricity is one of the oldest forms of renewable electricity generated in New Zealand. The first industrial hydroelectric power scheme was built in Otago in 1885 to power a stamp battery for mining. Today, there are almost a hundred hydroelectric power stations spaced throughout the country.

Hydroelectric power stations (***punahiko wai***) are often located along large bodies of water. Examples include the Tongariro Power Scheme in the North Island or the Tekapo Power Scheme in the South Island.

Do

Your students will build a model **water wheel** and use it to lift an object off the ground.

Materials:

- Large bowl (or kitchen sink)
- Jug of water (or tap)
- Empty plastic bottle
- Card (e.g. cereal box card)
- A4 or scrap paper OR a paper or plastic drinking straw
- A mug (to draw around)
- 3 x wooden skewers
- Blue tack
- Marker pen
- Tape
- Scissors
- Ruler
- Paperclip
- String

Instructions before the activity:

- Before class, either print or share online the final page from this document. It contains the instructions for making a water wheel.
- Start with a class discussion –what does your class know about hydropower? Is your school near a major river or large lake? Have you seen how fast water can flow, or ever felt the power of a strong water flow? Are there any local hydropower schemes close to your school?
- Split the class into small groups to build their water wheel. These water wheels can be built individually, but it will take less time working as a group.

- Give each group a set of printed instructions and the right materials. These can be found on the Activity Sheet on the last page of this document.
- Once each group has made their water wheel, they can test it out and try to engineer a way to lift an object off the ground.

Activity Instructions:

1. First, make some bearings. If you have paper or plastic drinking straws, cut two 4cm pieces. Or make some from a strip of scrap paper. Cut a strip 16cm wide from a piece of paper, roll it loosely around a wooden skewer into a long straw, and tape it in place. Take the skewer out, and cut the straw in half. Set these aside for now.
2. Now make the turbine blades. Cut the top and bottom off your bottle, and cut a line down through the middle section. If you're using something like a milk bottle, cut the top, handle and bottom off, then cut down the middle. Open the plastic up into one long strip.
3. Measure and cut six 4 x 10 cm rectangular strips of plastic from the bottle. Set them aside for now.
4. Now make the blade housing. Find something like a mug to draw around, which is about 10 cm across. Draw around it on the card twice, and cut out two circles.
5. Make a hole in the centre of each circle using your wooden skewer, into some blue tack if it's easier.
6. Draw a line across the middle of one circle, and divide each half into three sections, like pizza slices. Mark the edges of the circle where the ends of those sections would be in both halves, and then do the same on the other circle.
7. Line your two circles up so that you can see through the holes in the middle and the section marks line up on each side, and tape them together loosely, being careful not to put tape over your section marks.
8. At each section mark, make a small snip with your scissors, then another small one next to it, to make six small slots. Now you can cut the tape which holds your wheels together.
9. Cut two small circles of card, about the size of a bottle cap.
10. Assemble your turbine by threading your two small card circles onto your skewer and pushing them to the far end.

11. Thread one large card wheel onto the skewer, then the other one about 6 cm apart.

12. Slot one plastic blade into each slot on the wheel. If your plastic is curved, make sure that all the curves go the same direction.

13. Tape the blades to the wheels.

14. Take the bearings you made first of all, and slide one onto each end of the skewer.

15. Balance the skewer across the top of your bowl or sink, and bluetack the bearings onto the rim.

16. Cut a piece of string about as long as your arm, and tie one end to the skewer between the two small circles, which will be your spool guide. Secure it with a blob of blue tack.

17. Tie the loose end of the string to something you want to pull up or along.

18. Fill your jug with water and pour it over the blades to turn the turbine. You should see that the string winds up and the object moves.

How does a hydroelectric turbine convert water into electricity?

Electricity is produced through several **energy transformations.** This is a science topic that your students may not encounter until Level 4. Before you have introduced the topic of energy transformations, your students might start thinking about this process in terms of the forces involved.

Hydroelectric power stations use turbines to generate electricity. Inside a power station, water flowing through a pipe or penstock is used to turn the blades of a turbine, often by having the water fall from a height onto the blades. Your students modelled this with a jug of water in this activity.

Gravity pulls water downwards over the turbine. The force and weight of the water on the blades causes them to spin. The turbine blades are attached to a rotor (the spinning part of a generator). The spinning rotor inside the generator generates electricity. The force of magnetism is used to help generate electricity.

Steps to generate electricity

1. Water moves past the turbine blades, causing them to spin. This can be done by water falling from a height onto the turbine. The force of gravity, and the weight of the water, help to spin the blades. Potential energy is converted to kinetic energy when the blades are moving.

2. The spinning blades are attached to a rotor. This is a part of an electricity generator. The rotor spins around inside the generator.
3. As the rotor spins inside the generator, magnets attached to the rotor spin past iron plates. This generates an electric current.

Extension activities

- If you have access to electronic equipment, can the class use their turbine to generate electricity by lighting up an LED?
- Investigate what is the heaviest or largest object which can be moved using the water wheel.
- For older students, draw a diagram of the turbine, and identify the forces used to help generate electricity.

Extra resources

https://www.schoolgen.co.nz/for-teachers/resources/renewable-energy-solutions

https://www.schoolgen.co.nz/for-teachers/resources/hydro-turbine

We hope you have enjoyed this educational STEM resource.
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