genesis school-gen

Hydro turbine challenge

Overview

Students design and create a working hydro turbine model, using STEM knowledge and skills.

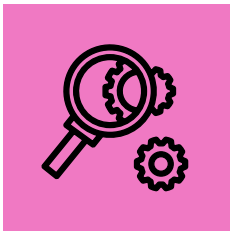
Curriculum links

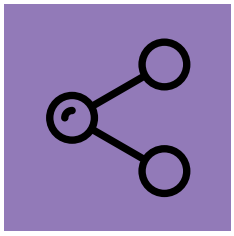
LEARNING AREAS	ACHIEVEMENT OBJECTIVES	LEVELS	YEARS
Science: Physical world; Physical inquiry and physics concepts	Explore, describe and represent the effect of force on the motion of objects. Identify and describe everyday examples of sources of energy, forms of energy and energy transformations.	3-4	5-8
Nature of science: Investigating in science	Build on prior experiences, working together to examine their own and others' knowledge.	3-4	5-8
Technology: Technological knowledge	Understand how different forms of functional modelling are used to explore possibilities and to justify decisions and how prototypes can be used to justify refinement of technological outcomes.	3-4	5-8
Other curriculum links	Maths: measurement.	3-4	5-8

Teacher information:
Hydro turbine challenge

Learning sequence


Introducing knowledge


Explore and investigate


Make and share


Reflect and extend


Make a difference

Learning intentions

Students are learning to:

- Explore and observe how energy from water is transformed by a model turbine
- Design a model turbine and reflect on their design and prototype.

Success criteria

Students can:

- Observe and describe the energy transfer from water to a hydro turbine model
- Describe and observe how a model turbine/turbines work. Reflect on turbine prototype design and suggest improvements.

Key concepts

- A hydro turbine converts potential (stored) energy into kinetic (moving) energy, which can be used to make electricity.
- Turbine structure and design can have an impact on energy transformations and outputs.

Resources needed

- School-gen video, 'Make a hydro turbine': https://youtu.be/2_4y9_oal3w
- Google slideshow: Hydroelectricity and turbines: https://bit.ly/2TQwrS6
- 3D printer, 3D printing equipment, see resources at: http://www.schoolgen.co.nz/make-and-play/maker-projects/make-a-hydro-turbine/

Vocabulary:

Turbine, water, water wheel, blades, axis, shaft, hydroelectric power station.

Background information and supporting resources

- Rivers, lakes and rainfall: Genesis Energy's hydroelectric power stations: https://www.genesisenergy.co.nz/assets/rivers-lakes-rainfall
- Hydropower 101 video on Youtube: https://www.youtube.com/watch?v=q8HmRLCgDAI

Learning experience suggestions

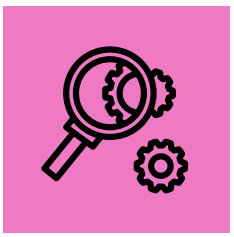
Note: These are suggestions only and teachers are encouraged to adjust this activity to suit the needs and interests of their students.

1. Introducing knowledge

Introduction:

Allow approximately 10 minutes

- View the Google slideshow: Hydroelectricity and turbines: https://bit.ly/2TQwrS6 to introduce key concepts to students (see page 2). Discuss what a hydro turbine is, how they transform energy and how they are part of hydroelectric power stations
- Establish prior knowledge of students and adjust learning experience accordingly.

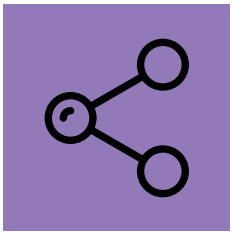


2. Explore and investigate

Allow approximately 20 minutes

Thinking like a scientist

- Examine model turbines or water wheels. Students can bring toy water wheels or water toys to school. Head outdoors in a rainy season with taps, water fountains or hoses to compare their structure, design and functioning.
- Discuss how the structure of the different water wheels/toys can affect the speed of the water going through them (energy transformations), e.g. bigger blades can move more water through, transforming more energy faster. Observe any changes when the water flow is adjusted.



3. Make and share

Allow approximately 40 minutes

Your challenge is to make a model hydro turbine!

- Use the concepts in the slideshow above, and observations from the water toys to design and design a working model hydro turbine. Create a turbine that will turn in water, converting water's potential energy into kinetic energy.
- Students could work in groups, pairs or individually to make/draw a turbine. Use the STEM challenge recording sheet on page 4 to guide your design.

Makerspace: 3D printing fun!

- Construct a working 3D printed hydro turbine model using the School-gen step by step guide and 3D files at: http://www.schoolgen.co.nz/make-and-play/maker-projects/make-a-hydro-turbine/ For tips and tricks for 3D printing, see: http://schoolgen.co.nz/teach-and-learn/3d-printing-101/
- Making one 3D turbine takes approximately 2.5 hours. Once you have constructed a model, students can take turns in groups to use and test it. If you don't have access to a 3D printer and would like to borrow the models to do this activity, please email schoolgen@genesisenergy.co.nz

STEM challenge recording sheet

Name: Date:

Challenge:	Design a hydro turbine
Criteria:	Your turbine must be waterproof and spin in water. It must have the parts of a turbine: blades, an axis and a shaft.
Materials needed:	
Plan *Draw a picture of your turbine design*	
Photo/observations of your prototype	
What worked well?	
What could be improved?	

Google Docs editable version of this recording sheet:
https://docs.google.com/document/d/1tMDdVDNPHqb9-lWIKdQCxudI6_EsicmEzDpWK_zTNT8/edit?usp=sharing

Other model ideas if you don't have access to a 3D printer

If you do not have access to a 3D printer, and you would like to borrow the models to do this activity, please email schoolgen@genesisenergy.co.nz. Otherwise you could construct a water wheel using the 'Introducing hydro power' activity for levels 1-2.
Or see these videos/ links for ideas for homemade models made from readily available materials:

- https://renewableteacher.wordpress.com/2009/12/10/model-hydroelectric-generator/
- https://www.youtube.com/watch?v=V3NtSp6aAbs
- https://www.youtube.com/watch?v=4Bt3psl_ge8
- https://www.sciencebuddies.org/science-fair-projects/project-ideas/Energy_p021/energy-power/using-hydropower-to-lift-a-load#procedure (note: the last two links are water wheels, not turbines)

Test your turbine prototype

Test your prototype turbine under running water.
Does it spin? Is it waterproof?
What can you observe about the energy from the water?

- Share ideas about how the models worked and discuss how their designs could be altered.
- Share your prototypes with your school or wider community.

4. Reflect and extend

- Reflect on how a hydro turbine works and what energy transformations happen when they are used.
- Record your ideas about what worked well and what could be improved on your prototype, using the STEM challenge recording sheet on page 4.
- Discuss how the structure of your turbine affected the transformation of energy. If you made more than one turbine, discuss the differences between them and their energy outputs.
- Look online for other water turbine design ideas. The 3D printed model we use is called a' Pelton turbine'. Other designs include: the Francis turbine, propeller turbine, Kaplan turbine or cross flow turbine.
- For other 3D printed turbine plans and ideas, see: Makerbot's Thingiverse, see: https://www.thingiverse.com/. At Makerbot's Thingiverse you can access past 3D designs of all kinds of wheels and turbines, as well as share your own designs!

Extra for experts: Design and make your own 3D printed hydro-turbine using a 3D modelling tool, such as: Tinkercad: https://www.tinkercad.com/, Sketchup: https://www.sketchup.com or another 3D modelling software programme.

5. Make a difference

It takes a lot of energy, money and effort to get electricity to our homes. Genesis Energy provides many New Zealanders with electricity using real-life hydro turbines. These are bigger and a different structure to the models described, however they do follow the same principles. How can you use less electricity in your classroom or home?

Some of our large, clean New Zealand rivers provide us with drinking water and electricity. How can you look after the precious water resources in your neighbourhood?