Lessons in a Backpack

United Nations Educational, Scientific and Cultural Organization

GEORGIAN BAY BIOSPHERE MNIDOO GAMII Spirit of the Water

Power From Water

Understanding Hydroelectric Power

Post Water Festival or Independent Lesson

(Cold Shot Chillers, 2013)

Description of Lesson

Students develop an understanding of what renewable energy is, why it is important, and the role of water in generating electricity. Students see how a hydroelectric dam works with a hands-on demonstration.

Connect with the Georgian Bay Biosphere

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GEORGIAN BAY BIOSPHERE MNIDOO GAMII Spirit of the Water

At a Glance

Grade Level: 5

Learning Environment: Classroom

Prep Time: 20 minutes

Length of Lesson: 50 minutes

Key Vocabulary: Hydrology, Hydroelectric Power.

Staffing: 1 educator

Materials:
Chart paper/black board/white board and marker
Video set up on YouTube
2L plastic soda bottle
Ruler
Marker
Craft knife
Scissors
2 corks
1 wooden barbecue skewer
Sewing thread (16 in)
Small object to lift (an eraser)
Sink
Duct tape
Larger funnel
Paper clips

Groupings: Class

Teaching/Learning Strategies:
Presentation, discussion

Lesson Outline

TIME	ACTIVITY	LOCATION	MATERIALS
15 minutes	Class Discussion	Classroom	YouTube, black/white board
20 minutes	The Power of Water		2L plastic bottle, Ruler, Marker, Craft knife, Scissors, 2 corks, 1 wooden barbecue skewer, Sewing thread (16 in), Small object to lift (an eraser), Sink, Duct tape, Larger funnel, Paper clips

Curriculum Expectations

Understanding Life Systems: Human Organ Systems
Overall Expectations
Analyse the impact of human activities and technological innovations on human health.
Specific Expectations
1.1 Assess the effects of social and environmental factors on human health. Propose ways in which individuals can reduce the harmful effects of these factors and take advantage beneficial factors instead. Assess human impacts on biodiversity and identify ways of preserving biodiversity.

Understanding Structures and Mechanisms: Forces Acting on Structures and Mechanisms
Overall Expectations
1. Analyse social and environmental impacts of forces acting on structures and mechanisms
Specific Expectations
1.2 evaluate the impact of society and the environment on structures and mechanisms, taking different perspectives into account and suggest ways in which structures and mechanisms can be modified to best achieve social and environmental objectives

Understanding Matter and Energy: Properties of and Changes in Matter
Overall Expectations
1. Evaluate the social and environmental impacts of processes used to make everyday products
Specific Expectations
1.1 Evaluate the environmental impacts of processes that change one product into another product through physical or chemical changes
1.2 Assess the social and environmental impact of using processes that rely on chemical changes to produce consumer products, taking different perspectives into account and make a case for maintaining the current level of use of the product or for reducing it.

Understanding Earth and Space Systems: Conservation of Energy and Resources
Overall Expectations
1. Analyse the immediate and long-term effects of energy and resource use on society and the environment, and evaluate options for conserving energy and resources
Specific Expectations
1.1 Analyse the long-term impacts on society and the environment of human uses of energy and natural resources, and suggest ways to reduce these impacts
1.2 Evaluate the effects of various technologies on energy consumption and propose ways in which individuals can improve energy conservation

Background

Renewable energy comes from earth's resources that are naturally replenished, on a human timescale such as sunlight, wind, rain, tides, waves/currents, and geothermal heat. Renewable energy technologies are "clean" sources of energy that have a lower environmental impact than conventional technologies. Oceanic currents, lake currents and dams are all components of the hydrology process as well as the water cycle.

Hydrology is the study of the movement, distribution, and quality of water, including the hydrologic cycle, water resources and environmental watershed sustainability. By harnessing these hydrologic processes, energy can be generated from water resources as a renewable energy source.

Hydroelectric energy is generated by hydropower, which is electricity collected from falling or flowing water. Many of the world's most powerful machines are driven by the power of water.

Hydroelectric power is a renewable resource that has helped fuel Ontario's energy needs since the beginning of the 20th century. Today, it accounts for more than one-third of Ontario Power Generation's electricity production. The following experiment will show the students how to make a water wheel with a handful of household materials, demonstrating how we can harness/capture different amounts of water to generate power.

Learn more from Ontario Power Generation: www.opg.com/generating-power/hydro/

The Cascade Street Generating Station, Parry Sound ON

Photo from Bracebridge Power Generation.

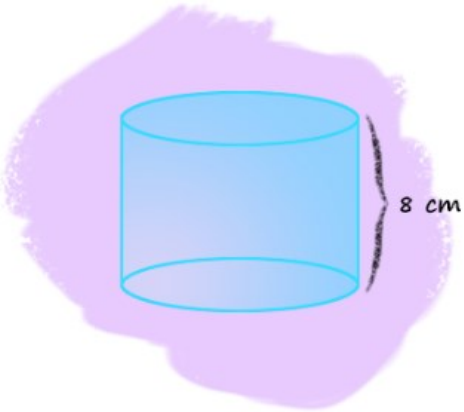
Teaching and Learning

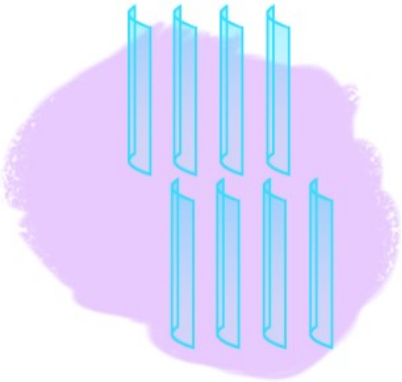
Part A. Class Discussion

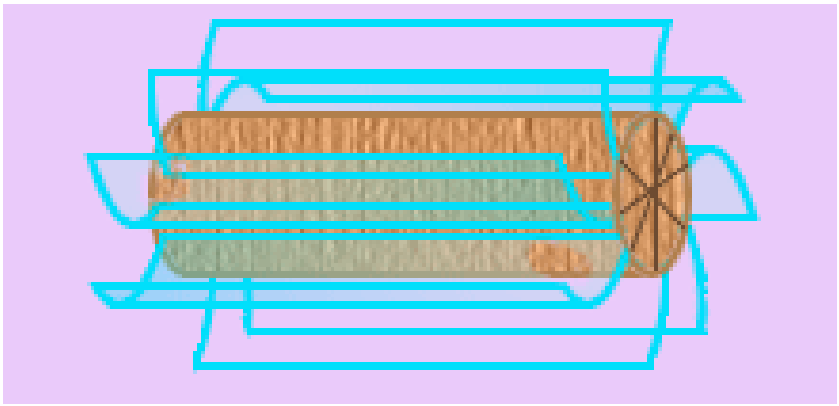
1. Ask students to brainstorm what energy is and who uses it. Discuss with the students what renewable energy is as well as examples and write down the student's answers on blackboard/ white board. Ask why renewable energy is important (Refer to background)
2. Watch *How It Works: Hydroelectric Power* www.youtube.com/watch?v=etreTW19hP8 (2 min)
3. Breakdown the words hydrology and hydroelectric energy on the board. (Refer to background).
4. Once students have a good understanding of what hydroelectricity is. Move on to the demonstration/experiment

Part B. The Power of Water

1. Demonstrate the building of the hydro-powered experiment for the class. You may wish to have the cutting done ahead of time.
2. Use the marker and ruler, measure and mark dots 6 cm up from the bottom of a 2L plastic bottle. Connect the dots and cut off the bottom using the craft knife.
3. Measure an 8 cm section from the cut part of the bottle, cut out this section so that you are left with a cylindrical section of plastic.
4. Cut four 2 cm-wide strips from the 8 cm section with the scissors. Cut these strips in half so you are left with eight strips that are 4 cm x 2 cm.
5. Draw 8 evenly spaced lines lengthwise on the cork, and make slits along each line with the hobby knife. Making sure that the plastic pieces all curve in the same direction, slide each 4 cm by 2 cm plastic piece into its own slit.

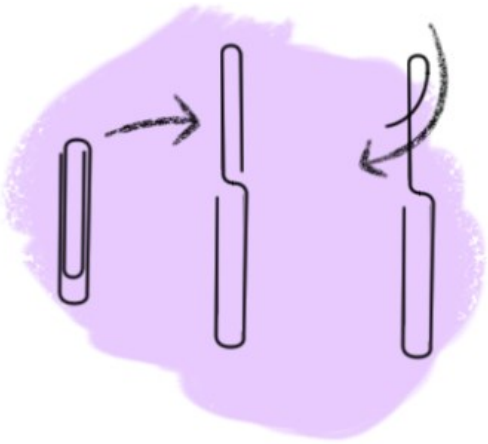




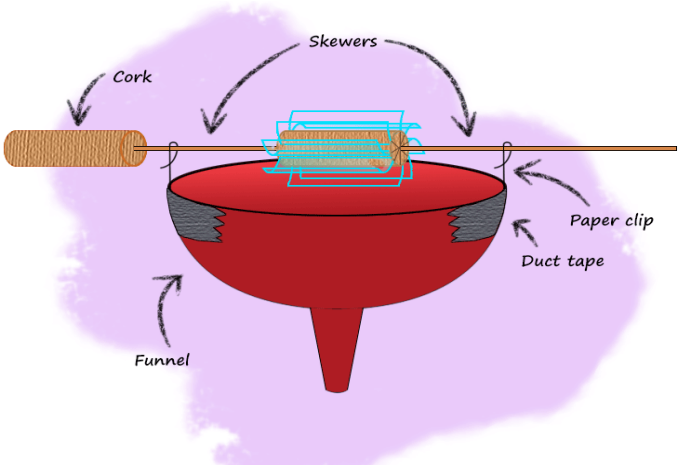


6. Unfold two paperclips and flex

one end of each to create a small loop. These paperclips will act as supports for the water wheel's axle.



7. Attach the supports on opposite sides of the funnel with duct tape.
8. Cut the skewer in half and poke each half into one side of the wheel cork. Guide each end through a loop on the paper clip support. Make sure the paper clip's loops are loose enough to allow the wheel to turn freely.
9. Insert one of the skewers into the other cork and tie thread tightly around it. Tie the loose end of the thread to a weight or other small household object.
10. Place your completed water wheel under a gentle stream of water in your sink or in cups for students to see up close. Slowly run water over the wheel so that the plastic pieces on the cork catch the falling water and turn it into mechanical energy.



10. Gather the students back in front of the chart paper/white board from before the experiment and discuss the results of the experiment. How was the wheel sable to spin? How does this relate to hydroelectric power?

Discussion/Results:

The wheel spins and produces enough energy to elevate small items tied to the end of the thread. Using the water from the faucet we generated hydropower. Gravity pulls water down toward the earth, and the weight of the water exerts rotation (a rotational force) on the water wheel. This *torque* provides enough energy to turn the skewer, allowing you to raise items attached to the other cork. Using the same concepts from your experiment, water wheels capture the force of powerful rivers, converting it into electricity and sending it into the electrical grid.

Extension

Field Trip Opportunity!
Take a walking field trip to the Cascade Street Generating Station and Dam in Parry Sound (or visit by bus). The station and dam make for quite the sight, located near the mouth of the Seguin River flowing into Georgian Bay.

Learn more: www.bracebridgegeneration.com/seguin-river/

And connect to local history: www.bracebridgegeneration.com/cascade-street-generation-station/

Part A. Wastewater Treatment Plant Process

1. Hand out the Wastewater Treatment Plant Process worksheet.

2. Discuss what a wastewater treatment plant is and where your local water supply comes from as well as why water treatment is important as well as why water protection is so important.

3. Play How Do Wastewater Treatment Plants Work? www.youtube.com/watch?v=FvPakzqM3h8

Ask students to listen carefully and fill out the worksheet during the video (stop the video at 2:31. Play the video again if the majority of the class missed blanks

4. Break the class into groups of 10, ask the students to arrange themselves into the correct order of the wastewater treatment process from the video using the 10 cards (each card naming one step of the wastewater treatment process).

5. After everyone is in the right spot in the process, they must come up with a sound and action that represents their word.

Part B. Create Your Own Constructed Wetland

1. Hand out the Create Your Own Constructed Wetland worksheet.

2. Display the images of the constructed wetlands on either an overhead slide or on a computer projector screen. Have students brainstorm what they might be looking at. Display the image with the blanks for each step/component within the constructed wetlands on the screen. Involve the students in answering/guessing what each step is and in filling in the blank for each while referring to the sheet constructed answer wetland

3. Have students draw their own plants and colour in the sections of the constructed wetland as well as the sun, pollinator's ext.

4. When the two activities are complete, have a discussion with the students about the similarities and differences between a wastewater treatment plant vs a constructed wetland. Hang student's constructed wetland designs around the classroom for classmates to see each other's work.