

Hydro Power and the Force of Water Lesson Plan

Consumers Energy's *Hydro Power and the Force of Water* Lesson Supports the Michigan Grade Level Content Expectations and Common Core State Standards

<i>Third</i>	
SCIENCE	
Inquiry Analysis and Communication	
<ul style="list-style-type: none"> ○ S.IA.03.11 Summarize information from charts and graphs to answer scientific questions ○ S.IA.03.12 Share ideas about science through purposeful conversation in collaborative groups ○ S.IA.03.13 Communicate and present findings of observations and investigations ○ S.IA.03.15 Compare and contrast sets of data from multiple trials of a science investigation to explain reasons for differences 	
Inquiry Process	
<ul style="list-style-type: none"> ○ S.IP.03.11 Make purposeful observation of the natural world using the appropriate senses ○ S.IP.03.12 Generate questions based on observations ○ S.IP.03.13 Plan and conduct simple and fair investigations ○ S.IP.03.14 Manipulate simple tools that aid observation and data collection ○ S.IP.03.15 Make accurate measurements with appropriate units ○ S.IP.03.16 Construct simple charts and graphs from data and observations 	
MATHEMATICS	
Measurement and Data	
<ul style="list-style-type: none"> ○ 3.MD.1 Solve word problems involving addition and subtraction of time intervals in minutes. 	
SOCIAL STUDIES	
Public Discourse, Decision Making, and Citizens Involvement	
P4.2 Citizen Involvement	
<ul style="list-style-type: none"> ○ 3 – P4.2.2 Participate in projects to help or inform others 	
ENGLISH LANGUAGE ARTS	
Reading Standards for Informational Text (RI)	
Integration of Knowledge and Ideas:	
<ul style="list-style-type: none"> ○ RI.3.7–Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur). 	
Writing Standards (W)	
Research to Build and Present Knowledge	
<ul style="list-style-type: none"> ○ W.3.8–Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. 	
Speaking and Listening Standards (SL)	
Comprehension and Collaboration	
<ul style="list-style-type: none"> ○ SL.3.1–Engage effectively in a range of collaborative discussions with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly. ○ SL.3.3–Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. 	
Language Standards (L)	
Conventions of Standard English	
<ul style="list-style-type: none"> ○ L.3.1–Explain the function of nouns, pronouns, verbs, adjectives, and adverbs in general and their functions in particular sentences. 	

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<i>Fourth Grade</i>	
SCIENCE	
Inquiry Analysis and Communication	
<ul style="list-style-type: none"> ○ S.IA.04.11 Summarize information from charts and graphs to answer scientific questions ○ S.IA.04.12 Share ideas about science through purposeful conversation in collaborative groups ○ S.IA.04.13 Communicate and present findings of observations and investigations ○ S.IA.04.15 Compare and contrast sets of data from multiple trials of a science investigation to explain reasons for differences 	
Inquiry Process	
<ul style="list-style-type: none"> ○ S.IP.04.11 Make purposeful observation of the natural world using the appropriate senses ○ S.IP.04.12 Generate questions based on observations ○ S.IP.04.13 Plan and conduct simple and fair investigations ○ S.IP.04.14 Manipulate simple tools that aid observation and data collection ○ S.IP.04.15 Make accurate measurements with appropriate units ○ S.IP.04.16 Construct simple charts and graphs from data and observations 	
MATHEMATICS	
Measurement and Data	
<ul style="list-style-type: none"> ○ 4.MD.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money. 	
SOCIAL STUDIES	
Public Discourse, Decision Making, and Citizens Involvement	
P4.2 Citizen Involvement	
<ul style="list-style-type: none"> ○ 4 - P4.2.2 Participate in projects to help or inform others 	
ENGLISH LANGUAGE ARTS	
Reading Standards for Informational Text (RI)	
Integration of Knowledge and Ideas:	
<ul style="list-style-type: none"> ○ RI.4.7-- Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. 	
Writing Standards (W)	
Research to Build and Present Knowledge	
<ul style="list-style-type: none"> ○ W.4.8-- Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. 	
Speaking and Listening Standards (SL)	
Comprehension and Collaboration	
<ul style="list-style-type: none"> ○ SL.4.1--Engage effectively in a range of collaborative discussions with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly. 	
Language Standards (L)	
Conventions of Standard English	
<ul style="list-style-type: none"> ○ L.4.1-- Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. 	

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Fifth Grade

SCIENCE

Inquiry Analysis and Communication

- S.IA.05.11 Analyze information from data tables and graphs to answer scientific questions
- S.IA.05.13 Communicate and defend findings of observations and investigations using evidence
- S.IA.05.14 Draw conclusions from sets of data from multiple trials of a scientific investigation

Inquiry Process

- S.IP.05.11 Generate scientific questions based on observations, investigations, and research
- S.IP.05.12 Design and conduct scientific investigations
- S.IP.05.13 Use tools and equipment appropriate to scientific investigation
- S.IP.05.15 Construct charts and graphs from data and observations

SOCIAL STUDIES

Public Discourse, Decision Making, and Citizens Involvement

P4.2 Citizen Involvement

- 5 - P4.2.2 Participate in projects to help or inform others

ENGLISH LANGUAGE ARTS

Writing Standards (W)

Research to Build and Present Knowledge

- W.5.8-- Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

Speaking and Listening Standards (SL)

Comprehension and Collaboration

- SL.5.1--Engage effectively in a range of collaborative discussions with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

Language Standards (L)

Conventions of Standard English

- L.5.1-- Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

Lesson Outcome

Students will identify how hydroelectric facilities use water pressure to work. They will make a makeshift dam using common household materials to help them understand how the water pressure is harnessed to turn a turbine. They will discuss how water pressure, the flow of the water, and distance using gravitational force creates electricity.

Rationale / Purpose for Lesson

This lesson will provide students an opportunity to take a look at how water pressure and the force of water can turn a turbine at a hydroelectric dam and create electricity. Students will learn that electricity can be made using water, a renewable resource. Finally, this experiment will reinforce the ideas of how energy is made using water pressure and what amounts of water pressure are needed to produce electricity.

Resources / Materials Required

- Print off one experimental worksheet below per student group
- Compile the supplies in the *What You'll Need* section of the experiment for each group

Anticipatory Set

Start the lesson by discussing how electric power was pioneered in Michigan along its rivers, and today Consumers Energy continues to operate 13 hydroelectric plants along five waterways (Au Sable, Kalamazoo, Manistee, Muskegon, and Grand Rivers). The hydro's were built between 1906 and 1935 and have a combined generating capacity of approximately 130 megawatts, enough to serve about 70,000 people. Near our hydro's are campgrounds, boat launches, picnic and other recreational facilities. They are popular spots for canoeing and fishing, and may visitors also enjoy bird watching and exploring the nearby nature trails.

Hydroelectric facilities are built at the base of dams to take advantage of the high pressure of the water at the bottom of the reservoir. The water pressure is funneled

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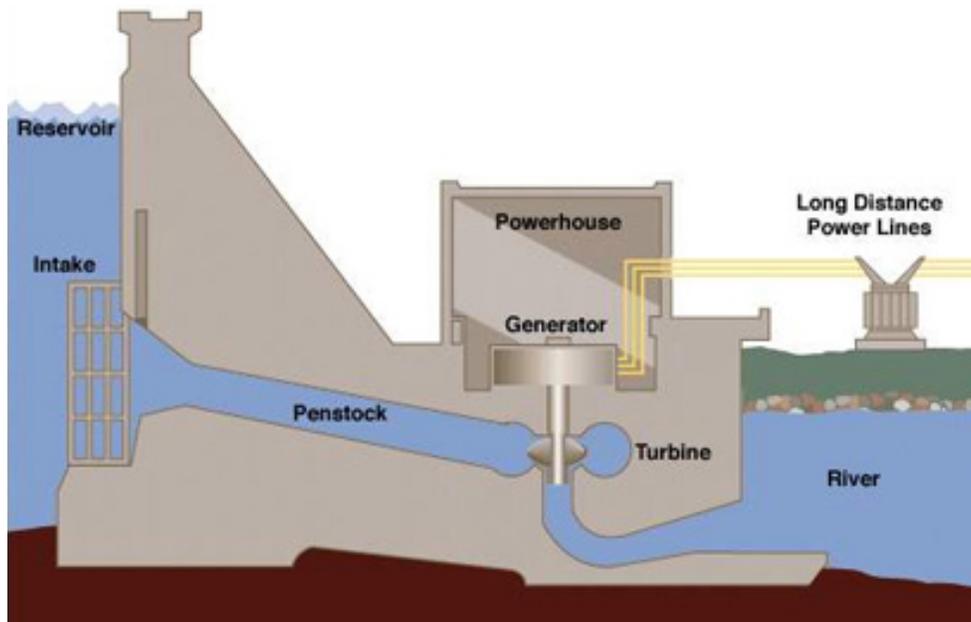
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through a tunnel through the dam called a penstock. The water then is focused on the blades of the turbine. The water pressure turns the turbine, and the turbine turns a generator making electricity.

- Hydropower uses the energy of moving water for a variety of useful applications.
- Hydroelectricity generates electricity by harnessing the gravitational force of falling water.
- Most hydroelectric power stations use water held in dams to drive turbines and generators which turn mechanical energy into electrical energy.
- Hydroelectricity is a renewable energy.
- Hydropower has been used to power watermills for thousands of years.
- The most common type of watermill grinds grains into flour.

Watch the streams of water flow and the distance of each in your experiment to communicate your findings to how dams work when making hydroelectricity.

How it Works



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Procedures

1. Divide the class into small groups.
2. Give each group one of the worksheets to complete.
3. Have the groups follow the directions on their handout and record their findings.
4. Repeat the experiment a few times to measure the waters stream and calculate the average of your measurements if time permits.

Closure

1. Have the students report out on their findings and discuss in small groups and as a class:
 - a. What did you discover after completing step 7?
 - i. How far away did the stream of water fall from the carton?
 - ii. Was there a difference between the streams of water from the bottom hole to the top hole?
 - iii. Why do you think this is?

Additional resources regarding information about dams that Consumers Energy owns and operates can be acquired at <http://www.consumersenergy.com/content.aspx?ID=1710>.

Name(s) _____

What You'll Need:

- Half gallon paper milk carton (empty and washed out)
- Gallon of water to fill carton with
- Nail
- Masking tape
- Ruler
- Permanent marker
- Scissors
- Pencil
- Tub for water to disperse into if no sink available in room

Experimental Procedure

1. Cut off the top of the juice carton. From the bottom of the juice carton, measure up $\frac{1}{2}$ inch and using the nail, punch a single hole in the center of the side of the carton. Measure up one inch from the bottom and punch another hole in the center. Measure up two inches from the bottom and punch a third hole above the other two holes. Measure up four inches from the bottom and punch a final hole in the center of the side. Note: All holes should be the same size in diameter.
2. Take a long piece of tape and tape up all four of the holes.
3. Put the carton on the edge of the sink with the side with the holes punched out pointing towards the sink.
4. Mark a line on the carton near the top. Always fill or refill the carton with water to this line.
5. Quickly remove the tape that is covering all four holes and watch what happens. Measure how far away each of the streams of water hits the sink. (you may have to do this more than once to measure all four holes)

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6. Let all of the water empty out. Watch what happens as the water level drops. What happens to the streams of water for each hole?
7. Now tape up all of the holes. Put the carton back on the sink edge, refill the carton, and remove the bottom tape. Measure how far out the stream goes. Retape the hole, and untape the next hole up, measure how far away the stream goes. Refill the carton with water. Retape the second hole and untape the third hole, measure how far away the stream goes. Refill the carton with water to the same level as before. Retape the third hole and untape the fourth hole, measure how far away the stream goes.

<u>Hole #</u>	<u>Distance of hole from bottom of carton</u>	<u>Distance of stream in sink or tub</u>	<u>1st Attempt</u>	<u>2nd Attempt</u>
1				
2				
3				
4				

Experiment adapted from <http://www.energyquest.ca.gov/projects/hydro-power>