Grades 6-8

Argonne NATIONAL LABORATORY

THE POTENTIAL POWER OF WATER
BE AN ENERGY SYSTEMS ENGINEER
Instruction Sheet

Did you know that you can capture energy from moving water? Scientists at Argonne study ways to make the best conditions to capture the most amount of energy from water, and they call it hydropower.

Hydropower is energy generated from moving water. It is a clean energy source that can help fill energy requirements when other sources of energy, like solar and wind energy, aren't generated (like when it is cloudy or not windy).

Hydropower works by transferring energy from potential energy to kinetic energy (energy in motion). Head and flow are an important part of this. Head is the change in water levels from the place where the water comes into the place where water comes out. It is a vertical height. The bigger this height is, the bigger the head is. With a bigger head, there is more water pressure, which means more power is generated. The flow of water is also important, and because it measures the volume of water passing through the hydropower site. The higher the flow, the more energy is generated.

MATERIALS

- A small cup
- A clear straw or dropper pipette
- Water & pitcher/cup
- Food coloring (optional)
- Ruler/measuring tape
- A paper
- A marker

DIY Water Turbine system

- Adhesives (hot glue, duck tape, etc.)
- String
- Basin/bucket, sink, or tub
- Cardboard
- A pair of scissors or an exacto knife
- A wooden dowel
- Binder clips
- Water flow generator (optional)

Image by Shutterstock / Alberto Masnovo

ACTIVITY HIGHLIGHTS

- **NGSS MS-PS3-2.**
- **Develop a model to describe when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.**
- **NGSS MS-ETS1-3.**
- **Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.**

GUIDING QUESTIONS

- **How does energy transfer?**
- **How does water generate energy?**
- **How can we generate more energy?**

U.S. DEPARTMENT OF ENERGY
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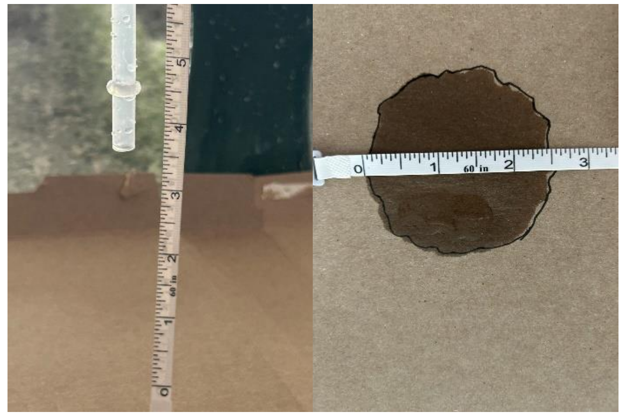
Part 1

In Part 1, you will explore potential and kinetic energy. This is adapted from the activity [“Falling Water”] (Zamora-Thompson et al., *Falling water - activity* 2022).



1. Fill a cup with water, and if you want, add in a few drops of food coloring.
2. Mark a line a few centimeters from the end of your straw or use a dropper pipette.
3. Fill your dropper pipette or fill your straw to the line with water by dipping it up to the line into the water and using your finger to plug the top hole.
4. Measure a specific height above your paper and place the bottom of your straw at that height above the paper.
5. Unplug the hole and let the water splash.
6. Draw a circle tightly around the splash area and measure how wide the circle is. Use the data table on page 4 and graph your results.
7. Refill your straw to the same amount, but this time, drop the water from a different height. How does the height affect the size of the splash?
8. Repeat two more times at two more heights.

Part 2

In Part 2, let’s make a basic turbine to see how it works. Steps 1-3 are instructions on how to make a basic turbine from cardboard; however, you can use a different tutorial or purchase a turbine.

1. First, have an adult help you cut out cardboard according to the image on the right.
2. Cut 4 slits into the circle at the ends of each rectangle. Slot the rectangle cardboard pieces into the slits as show in the image on the right.
3. Use hot glue or another adhesive to secure and allow to dry.
4. Next, you’ll need to set up your basin. Clip binder clips on each side. You may need a smaller and larger clip depending on the size of your dowel. You can also use a bucket, sink, or tub. The important thing is that the dowel can freely rotate.
5. Insert the dowel into the turbine and place it over the basin between the clips.
6. Pour some water, and you should see that the turbine and dowel move/rotate.

Part 3

In Part 3, you will brainstorm and design a model to demonstrate how as you increase the head height, the flow increases and more energy is generated/transferred. You will need to collect data to prove it is a working model.

1. Start with your basic model from Part 2. As the turbine moves, design a way it can carry and lift small weights. This will need to be something we can measure (aka the dependent variable). For example, the number of pennies or marbles the turbine can lift.
2. Next, what can you do or change to represent different head heights (independent variable)? Think back to the splash experiment. What did we change each time to show the effects of increasing potential energy?
3. Build your design and test it out. Try your model using different head heights. How does your dependent variable compare at different head heights?
4. Collect data to prove that your model supports the relationship between increase in head height and power generated.

Discussion Questions

1. What did you notice about how the height and amount of water impact the flow of water?
2. How do you think scientists increase or decrease the flow of water?

"SPLASH" POTENTIAL ENERGY ACTIVITY TABLE

Complete the data table for Part 1. What conclusion can you make? How does head height affect the diameter of the splash? Does increasing the head height increase or decrease the potential to kinetic energy?

Head Height	**Diameter of "Splash"**			
	Trial 1	**Trial 2**	**Trial 3**	**Average Diameter**
25 cm				
50 cm				
75 cm				
100 cm				
Conclusion:				

Diameter of Splash

Head Height

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Data Sheet

Draw a picture and explain how your model works, and how it proves that an increase in head height increases the power generated. On the next page, collect your data from your experiment and graph your results.

Head Height **[insert dependent variable]**

	Trial 1	Trial 2	Trial 3	Average
Conclusion: