Grades 3-5

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 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
- 40 pennies (or alternative weights)
- 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
- Turbine (optional or can make your own with supplies above)

*Image by Shutterstock / Alberto Masnovo*

### ACTIVITY HIGHLIGHTS

- **4-PS3-4**
- **Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.**

### GUIDING QUESTIONS

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

## Part 2

In Part 2, you will create a water turbine and use it to lift different weights. **Skip steps 1-3 if you have purchased/already have a turbine to use or plan to use a different DIY tutorial.**

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. Next, take a small cup or cut the bottom of a Styrofoam cup and make a small hole on each side of the cup.
7. Tie one end of the string through the holes of the cup and the other end around the dowel. Secure with tape if needed. Tip: If possible, get a dowel rod long enough that the cup can hang outside the basin to avoid it getting wet.
8. Pour water from a pitcher/cup over the turbine to make it spin. Your string should easily wrap

around the dowel, making the cup rise. Adjust if needed.

9. Once your cup reaches the dowel, stop pouring and unwrap the string and cup so that it hangs freely again. Put 5 pennies into the cup and pour your water again. Make sure you are using the same flow.
10. Once the cup now with 5 pennies rises to the top, try again with 5 more pennies. Repeat this until the cup no longer rises.
11. How many pennies were you able to successfully lift using the power of water?

## Part 3

In Part 3, you will explore how different head heights and pressures impact your turbine.

1. Just like the splash experiment, you will pick 3-4 different heights to pour out the water from. This is the head height.
2. How does increasing the head height affect the number of pennies that can be lifted?

## Discussion Questions

1. What did you notice about how the height and amount of water impact the flow of water?
2. How can you lift heavier weights?
3. 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: | | | | |

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Data Sheet

**Head Height** **Number of Pennies**

| | Trial 1 | Trial 2 | Trial 3 | Average |
|---|---|---|---|---|
| 25 cm | | | | |
| 50 cm | | | | |
| 75 cm | | | | |
| 100 cm | | | | |
| Conclusion: | | | | |