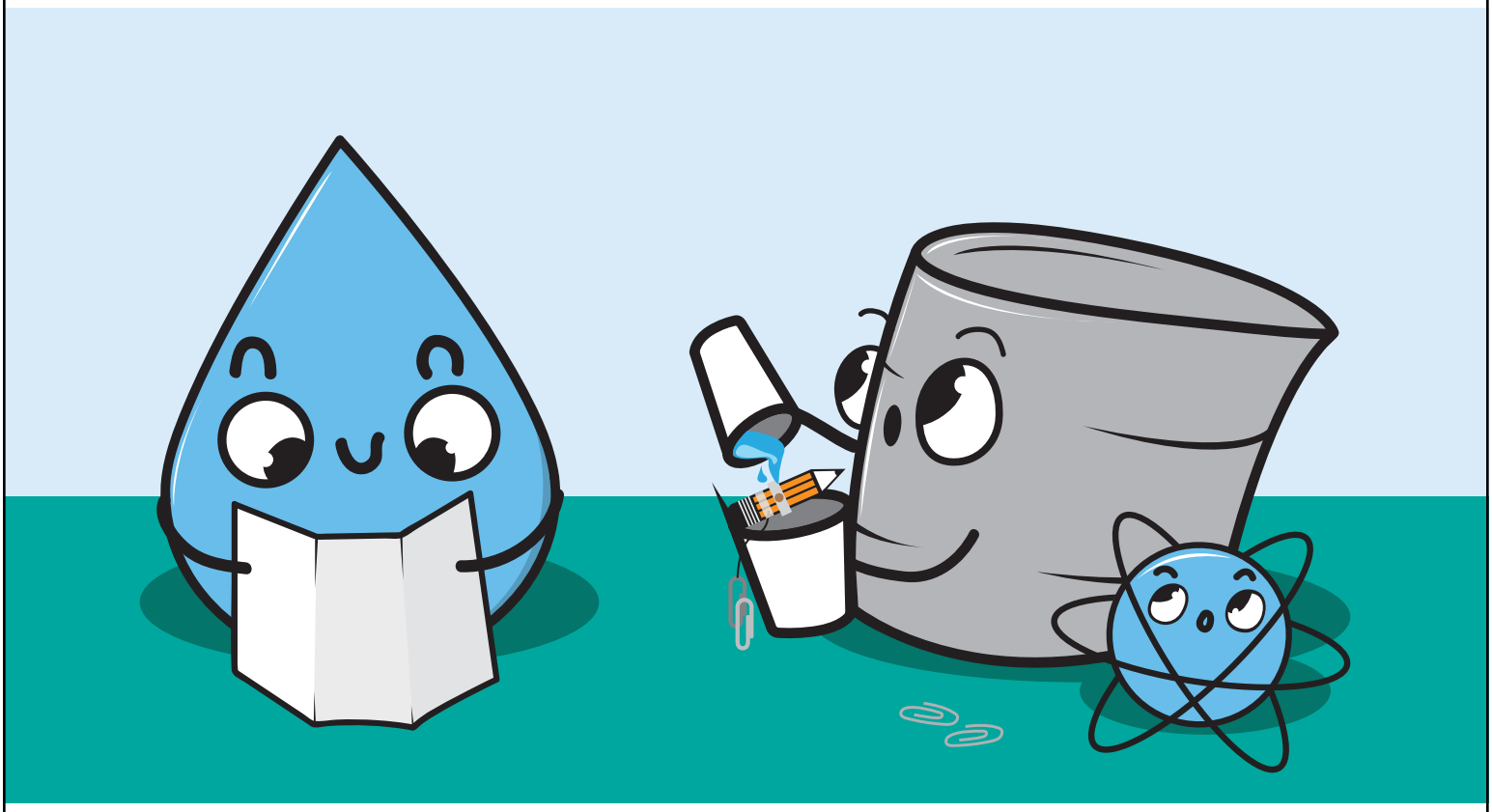
EVERSOURCE

Home Energy Challenge - Earth Day 2022 Edition

Families work together to explore how water does work to move things, lift things, and power our devices.



NEED National Energy Education Development Project

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What's In The Kit

- 1 Wooden skewer
- 1 Foam craft ball
- 2 Foam cups
- String
- 5 Wooden spoons
- 10 Paper clips

What Else Will We Need?

- Scissors
- Tape
- Glue
- Ruler
- Stopwatch (optional)

⚠ Safety Notes

- White school glue will work for this activity, but it will require waiting until the glue dries. A low temperature, hot glue gun is recommended for faster, more secure gluing. Use caution with hot glue guns, as the glue and the glue gun can cause skin burns. Always place the glue gun on top of a placemat or paper plate to protect tables from glue gun leaks.
- This activity will use scissors to cut through foam, and perhaps even wooden spoons. Use caution when cutting, and always cut away from your body. The wooden spoons snap easily by hand, but safety glasses are suggested if you have them.
- Make sure an adult is present when using a hot glue gun or scissors.

✪ Background Information & Overview

Water is essential to our lives. We need to drink it to keep our bodies healthy. It is essential for growing plants. Water was used for centuries to do work like grinding grain and moving heavy items, and it still is used this way today. Water is also an important part of how we generate renewable electricity. As water flows from a waterfall, down a river or stream, or even through a pipe in our public water system, we can use the motion energy of the moving water to turn blades of a turbine and spin a generator. We call the energy of moving water hydropower. Hydropower is used to generate electricity in many locations across New England, using the natural movement of large and small rivers and streams like the Connecticut and Merrimack. Hydropower facilities generate electricity for homes, towns, businesses, and industries without creating any pollution or emissions. As long as the river is flowing, electricity can be generated. Hydropower is very efficient for electricity generation.

Most hydropower facilities have a power station. This power station allows water to flow through it to do work and generate electricity. Water flows through a turbine. This turbine often looks like a big propeller on a boat. The water spins the blades on the turbine. The turbine is connected on an axle to the generator that spins when the turbine spins. When they move, they generate electricity. Let's go with the flow and build our own hydropower turbine. To keep things simple, this turbine will do work to lift the weight of a few paper clips, much like a mill. You will experiment to see how many paper clips can be lifted by your turbine. After you test your model, you can explore how to enhance its design to lift more. As an optional challenge, you can time your weightlifting and crunch some numbers to determine how much power your turbine could produce, if it were to generate electricity.

Conservation Tips

Water is an important resource that we should aim to conserve when possible. Collect and re-use the water after each trial with your turbine. After you've completed the activity, make sure to use the water to do some cleaning or water plants.

Consider all the ways you can re-use the foam cups from the activity. Use the cups to water plants, for house cleaning, to fill up your pet's water dish, for rinsing hair in the bathtub, and more. Try to get as many uses out of the cups as you can before you discard them!

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Question

▪What is the maximum load that can be lifted all of the way to the top of the hydropower turbine?

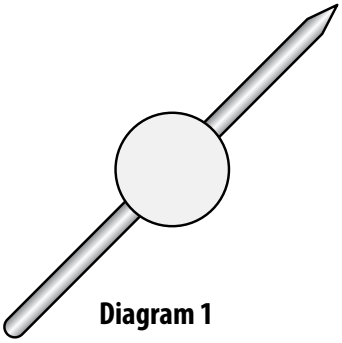

Diagram 1

✔Procedure

1. Make a hole through the middle of the foam ball with the skewer as shown in Diagram 1. Slide the foam ball to the middle of the skewer. Place rings of glue on either side to secure the ball to the skewer.
2. Use the wooden spoons to create your turbine blades. Carefully snap the spoons in half. The edges may be rough. Insert the "blades" into the foam ball at equal distances from each other, as shown in Diagram 2. Spin the turbine to make sure the blades have room to rotate in the cup. You can trim the edges with scissors, to make sure the blades are short enough without hitting the edges of the cup. Ask an adult for help with this step! Glue the blades into place and let them dry.
3. Cut two small V-shaped grooves on opposite sides of the top of the cup as shown in Diagram 3.
4. Tie one end of a piece of string to a paper clip. Tape the other end of the string to the skewer as shown in Diagram 4.
5. Place the skewer into the grooves on the cup so the foam ball is in the center of the cup. If necessary, adjust and re-glue the blades so that they do not hit the edge of the cup as shown in diagram 4.
6. When the glue on the blades is dry, place the water wheel turbine system at the edge of a table so the one paper clip hangs off the table.
7. Take the second cup and fill it nearly full with water. Pour the water slowly and evenly onto the blades, as shown in Diagram 5. What happens? Record your observations.
8. Keep adding paper clips one at a time to determine the maximum load that can be lifted all of the way to the top. How many can you lift? Record your data on the Data Collection Form.
9. How could you change the design of your turbine to produce more work from the system? Record your ideas on the Data Collection form.

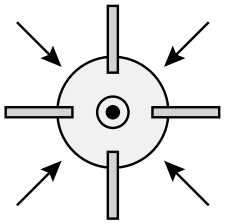

Diagram 2

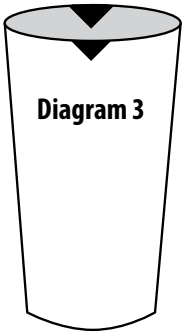

Diagram 3

Math Challenge: Do you have the power?

Power = $\frac{Energy}{Time}$

Conduct a trial by recording the time it takes to lift weight all the way to the top.

1. To calculate energy –
   Energy (Joules) = gravity * mass * height
   Gravity = 9.8 m/s^2
   Mass = mass of your paper clips in kilograms (1 paperclip is roughly 1 gram or 0.001 kg)
   Height = length of your string from bottom to top in meters. (35 cm = 0.35 m)

   Plug it in: Energy = 9.8 m/s^2 * _____kg * _____m

   Energy of your weightlifter = _____Joules

2. Complete the calculation to find power in watts.

Power (Watts) = $\frac{Energy}{Time}$

Energy (calculated above): _____

Your time to lift: _____

Plug it in: Power = $\frac{\text{\_\_\_\_\_(energy)}}{\text{(time)}}$

Power of your weightlifter= _____Watts

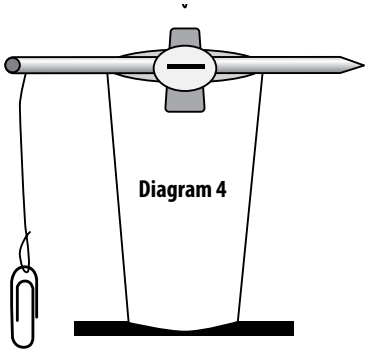

Diagram 4

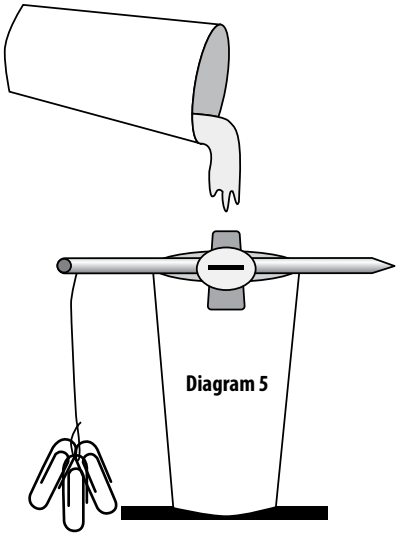

Diagram 5

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Final Data Collection & Submission Form

Submit this form to share your data and photos of your family completing the Eversource Home Energy Challenge - Earth Day 2022 Edition Activities to be entered in our prize drawing.

Student Name: _____

Student Address: _____

Student Grade: _____ School:_____

Parent Email:_____ Parent Phone Number:_____

Data

Number of paper clips lifted _____ ***(optional)* Power Produced** _____**watts**

1. What modifications could you make to your turbine to help it lift more mass or produce more power?

2. How did you recycle or reuse the water from your turbine tests?

3. Email or mail this form and pictures of your student working on the project to win an iPad. Submissions are due on or before April 20, 2022:

   Email: info@homeenergychallenge.com

   Mail:
   Eversource Home Energy Challenge
   P.O. Box 2353
   South Hamilton, MA 01982
   ATTN: Scott Halstead

4. Optional (but encouraged): Post a photo of your weightlifter turbine on your social media channels (Facebook, Twitter, Instagram, etc.). Use #HomeEnergyChallenge and tag Eversource in your particular state: @EversourceMA, @EversourceCT, or @EversourceNH. **Posting on social media does not increase your chances of winning.*

x _____

By signing this form I confirm that I am a legal U.S. resident residing in one (1) of the Massachusetts, New Hampshire, and Connecticut communities listed in the Official Rules, am eighteen (18) years of age or older, and am a parent or guardian of a current student in grades K-12. Visit our website for official rules **www.homeenergychallenge.com**.