



BE A CLEAN ENERGY CHAMPION



Be a Clean Energy Champion

When you flick on the light switch at home, have you ever wondered where the power to light up the bulb comes from?

Electricity is a form of energy that is created by a variety of generating sources.

Some of these sources are better for the planet than others. For instance, coal produces pollutants like carbon dioxide and other greenhouse gases that contribute to climate change, and it's not renewable – once it's used, it's gone forever.

But clean energy sources create almost no air pollution. There are many types of clean energy, including solar panels that convert sunlight to electricity and hydroelectric stations that harness the power of water. And carbon-free nuclear generation uses tiny little uranium pellets to generate electricity.

About 96% of Ontario's electricity comes from clean energy sources. We get about 60% from nuclear power and 26% from hydroelectricity, with wind and solar also contributing to the mix.¹

As one of Canada's largest clean generators, Ontario Power Generation (OPG) operates a diverse fleet of clean energy sources. The company is now working to expand this fleet with new clean technologies so we can power even more things – like electric cars– and do more to fight climate change.



ONTARIOPOWER
GENERATION





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Your mission: Become a Clean Energy Champion!

To complete this Mission, you must:

- Read this Mission Brief and build your very own hydropower water wheel.
- Set up your water wheel at home and take a picture.
- Explain which form of clean power you think is the coolest and why.

There are many types of clean energy. Climate Guardian **Newton**, an Ontario Black Bear who specializes in clean energy, will guide you through a few of them.

Hydroelectric energy



Have you ever gone camping near a river? Remember the rushing sound of water? There's a lot of mechanical energy potential in that flow of water. Hydropower captures this flow and turns it into clean energy. It's one of the oldest forms of clean energy in the world.

There are hundreds of hydroelectric stations across Canada. At these stations, you'll see water flowing through a turbine – kind of like a large fan – which makes it spin. This spinning motion causes an electrical generator connected to the turbine to spin and create electricity.

Newton says: Did you know hydropower is the leading source of energy in Canada? In fact, the country is the third largest producer hydroelectricity in the world. That's a lot of clean energy!





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OPG operates 66 hydro stations in Ontario – and the company is continuing to develop and improve these stations to help combat climate change.²

Nuclear energy



Nuclear energy gets down to the atomic level to harness clean power that emits almost zero air pollution. Inside a reactor at a nuclear power plant, atoms are split apart to form smaller atoms – a process called nuclear fission. This releases great amounts of energy, enough to boil water to really, really high temperatures! This heated water produces steam, which is used to spin large turbines that generate electricity.

Newton says: Did you know about 60% of all power in Ontario comes from nuclear power plants? OPG operates two of those stations – the Darlington and Pickering nuclear generating stations.

Biomass energy



Did you know it's possible to generate energy by burning wood and even poop? Biomass energy is created when organic matter, like plants and wood chips, are burned. Special technology captures the heat and steam from this burning process and turns it into electricity.





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Newton says: Did you know OPG operates a station that was converted from burning coal to biomass? The Atikokan Generating Station is now the largest 100% biomass-fueled plant in North America.

Solar energy



There's nothing better than a clear blue sky and a sunny day to enjoy the outdoors. The sun gives us warmth, light, and lots of clean, photovoltaic energy. This is electricity generated by the sun's light, or photons, shining on a solar panel. Solar panels are a bunch of photovoltaic cells stuck together, which are very good at absorbing tiny bits of solar energy and converting it into electricity. Some watches and calculators are powered by tiny photovoltaic cells. And solar panels are even used to power space stations in space! At OPG's Nanticoke Solar facility, you will find more than 190,000 solar panels, which generate enough clean energy to power a small town.

Newton says: Did you know that the sun produces enough energy in just one hour to equal all of the energy humans need in a whole year?





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Wind energy



Tall machines called wind turbines capture wind energy. When the wind blows, the blades start to spin, causing a motor in the turbine to generate electricity. Solar and wind energy are considered forms of “intermittent power”, as they rely on the right weather conditions to generate electricity.

Geothermal energy



Deep underground, the earth is constantly generating heat. Geothermal energy is created when special machines access heat from deep in the ground. This heat is turned into electricity that can power our homes.





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Mission

Hydropower is one of the oldest forms of energy, and has been used by humans since 4,000 BC! Now you can learn how to generate power using water with this water wheel experiment.

Reference for graphics only: <https://www.education.com/science-fair/article/water-produce-energy/>

Here's what you'll need:

- 2-litre plastic soda bottle
- Ruler
- Marker
- Craft knife (have an adult help you use it)
- Scissors
- 2 corks
- 1 wooden barbecue skewer
- Sewing thread (16 inches)
- Small objects to lift (for instance, an eraser)
- Sink
- Duct tape
- Large funnel
- Paper clips





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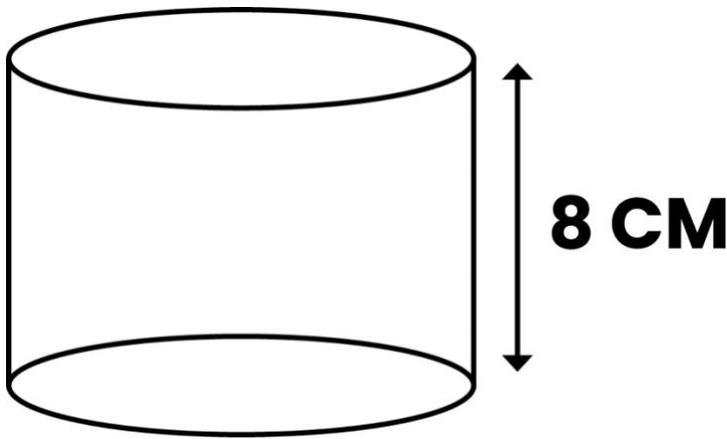


Step 1

Using your marker and ruler, measure and mark a few dots 6 cm up from the bottom of the soda bottle. Connect your dots and have an adult help you cut off the bottom using the craft knife.

Step 2

Measure an 8 cm section from the cut part of the bottle. Cut out this section so that you have a cylindrical section of plastic.



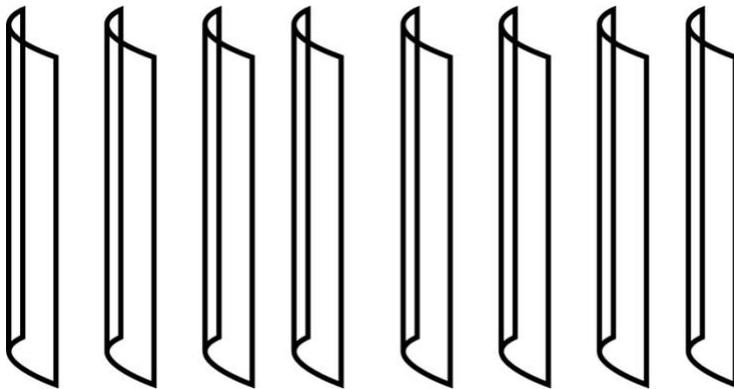


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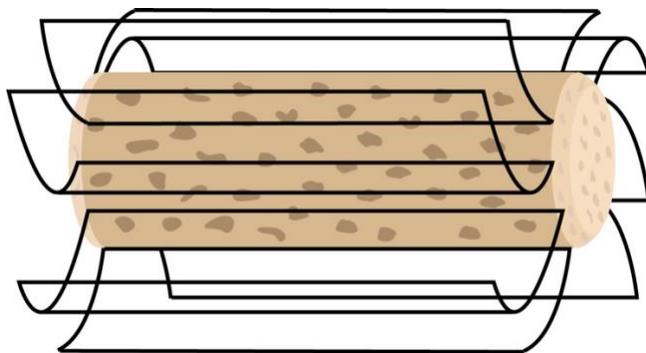
Step 3

Cut four 2 cm-wide strips from the 8 cm section with your scissors. Cut these strips in half so you are left with eight curved strips that measure 4 cm by 2 cm.



Step 4

Draw 8 evenly spaced lines lengthwise on the cork, and make slits along each line with your craft 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.



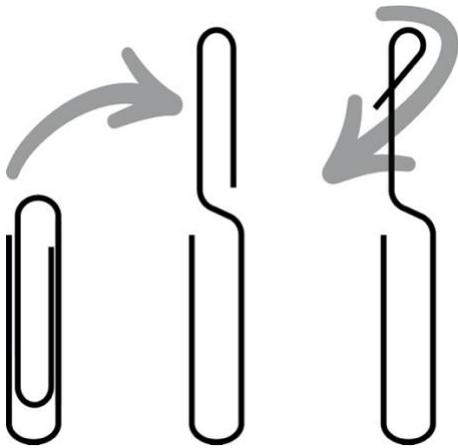


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Step 5

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.



Step 6

Affix your supports on opposite sides of your plastic funnel using your duct tape.

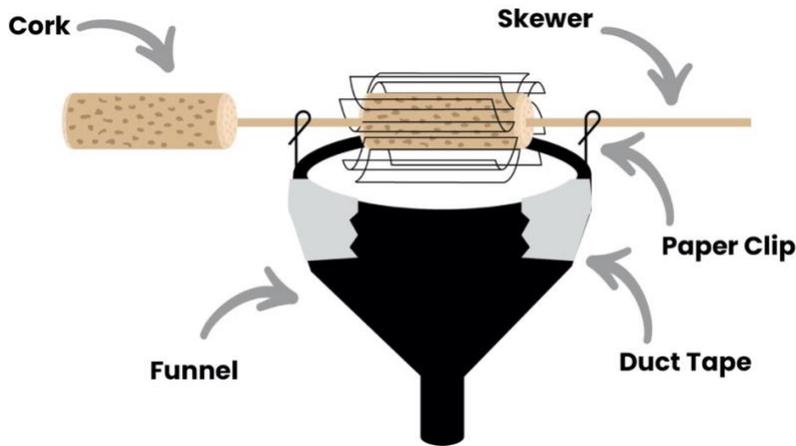
Step 7

Cut the skewer in half and poke each half into one side of the wheel cork. Guide each end through a loop on your paper clip support. Make sure your paper clip's loops are loose enough to allow the wheel to turn freely.





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Step 8

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.

Step 9

Place your completed water wheel under a gentle stream of water in your sink. Slowly run water over the wheel so that the plastic pieces on the cork catch the falling water and turn it into mechanical energy.

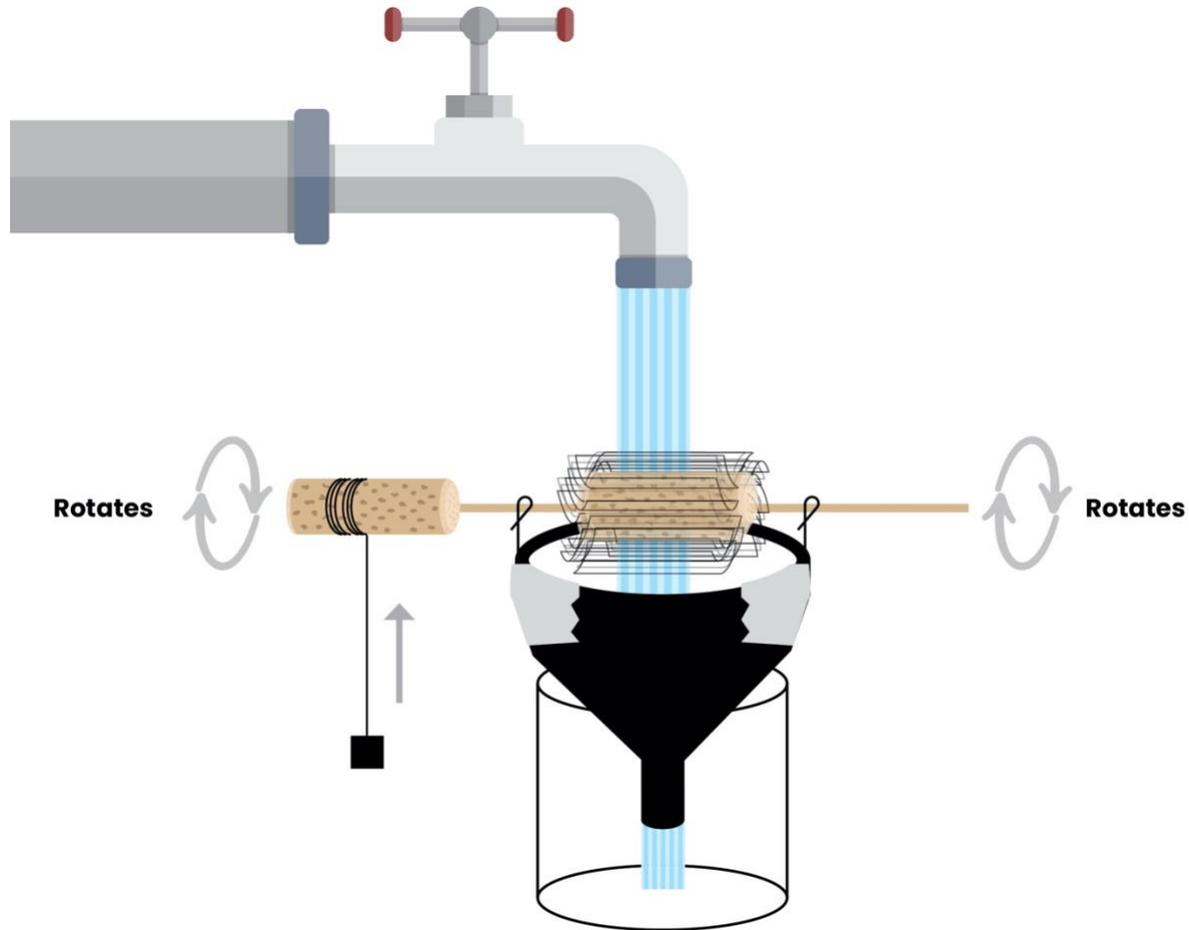
Result

The wheel spins and produces enough mechanical energy to elevate small items tied to the end of the thread. You just generated hydropower using the water from your faucet! Gravity pulls water down toward the earth, and the weight of the water exerts torque (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.





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Did you notice that more water pressure was needed to lift heavier objects? More energy is needed to lift heavy items than lighter ones, and by increasing the flow of water you generated more power.

This same concept is used to capture the force of powerful rivers at hydroelectric stations across the country.

Now that you understand hydropower and other forms of clean energy, you're well on the way to being a Clean Power Champion. Which form of clean power





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do you think is the best for our future? Or do you think we will need all of these sources to fight climate change?

When you've completed this experiment, download your Mission certificate. Don't forget to check out our website for the next mission in the Climate Guardians series.

Visit the next mission by visiting <https://www.opg.com/climateguardians>

¹(<https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-ontario.html#:~:text=In%202018%2C%20about%2096%25%20of,natural%20gas%2C%20with%20some%20biomass.&text=Ontario%20leads%20Canada%20in%20wind%20capacity.>)

²<https://www.nrcan.gc.ca/our-natural-resources/energy-sources-distribution/renewable-energy/about-renewable-energy/7295#geo>

