

STEM^{in the}lab

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GEOHERMAL PINWHEEL POWER



GRADE LEVELS

This activity is appropriate for grades 2-6.



VOCABULARY

ALTERNATIVE ENERGY: any energy source that does not use fossil fuels (coal, gasoline and natural gas). Renewable energy comes from natural sources that don't run out. The alternative energies that are already being used are solar, wind, geothermal, hydroelectric, tidal, biomass and hydrogen.

ENERGY: power derived from the use of physical or chemical resources, especially to provide light and heat.

GEOHERMAL POWER PLANT: a geothermal power plant uses steam to turn a turbine. The turbine is attached to a generator. The generator turns to make electricity.

STEAM: the vapor into which water is converted when heated, or water in its gas state.

SUSTAINABLE RESOURCE: a resource that can be continuously replenished, or there is an endless amount of it that can be captured or harnessed. They can be useful towards providing energy without decreasing supply.



MISSION

Build your own geothermal power plant to turn a toy pinwheel.



MATERIALS

- » Small child's pinwheel*
- » Aluminum foil
- » Saucepan
- » Hot pad (mitten type)
- » Access to a stove
- » Pencil or pen (to punch a small hole in aluminum foil)

**you can also make your own pinwheel using the instructions on the next page*

ABOUT THIS ACTIVITY

At Idaho National Laboratory, scientists and engineers are working to improve the quality of our water supply. The Water Technology Innovation Program at INL is leading the way in water technology innovation by working to find ways to increase water recycling efforts and develop less water-intensive technologies used in the energy, manufacturing, and agricultural industries. One project the WTIP is working on involves geothermic water. Geothermic water has significant value in terms of mineral content and heat, which can be used to drive separation processes to yield valuable products. If you were to dig a big hole straight into Earth, you would notice the temperature getting warmer the deeper you go. This is because the inside of the Earth is full of heat. The heat released is called geothermal energy. In this activity, students will build their own geothermal power plant. The steam made from this activity will turn a toy pinwheel.

INSTRUCTIONS

This activity involves using heat from a stove and might require adult supervision.

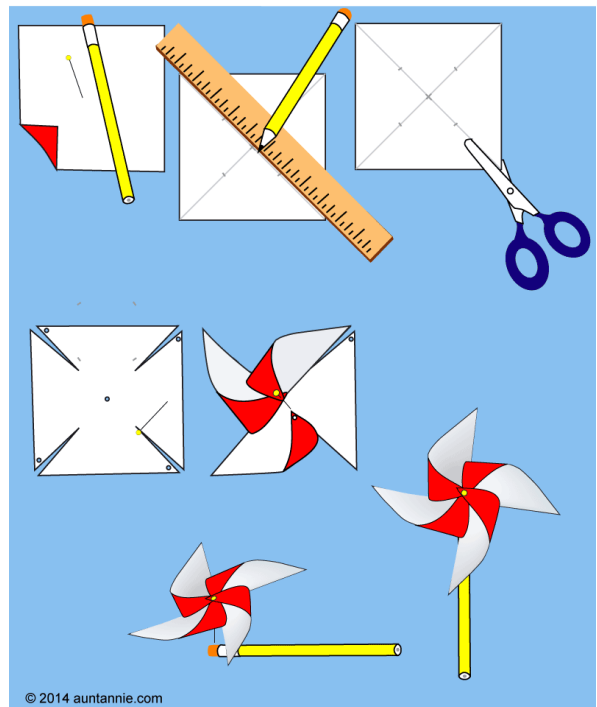
1. Fill a saucepan half full of water.
2. Cover the top of the saucepan with two layers of aluminum foil. Make sure the foil completely covers the top of the pan. Once the top is covered, wrap the foil around the edges so that it seals the top and no air can escape.
3. Using a pencil or pen, punch a hole through the two layers of tin foil cover in the center of your pan. The hole should be about $\frac{1}{16}$ inch across, about the size of the pencil lead or the tip of the pen.
4. Put the pan onto the stove and bring the water to a boil.
5. Put on the mitten hot pad.
6. When steam starts coming out of the hole, carefully hold the pinwheel over the center hole. Notice how fast the pinwheel turns.
7. Steam is a sustainable resource. Take the pan off the stove and notice what happens to the pinwheel as the water starts to cool.

HOW TO MAKE A PINWHEEL

Source: <https://www.auntannie.com/FridayFun/Pinwheel>

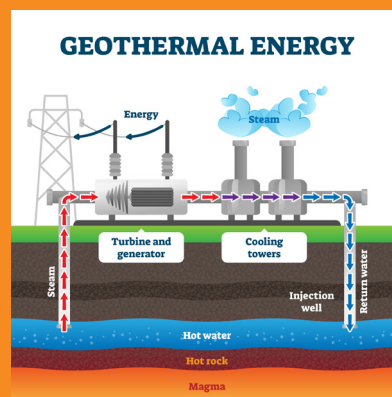
1. Gather your materials: paper, unsharpened pencil with eraser, straight pin with ball on top, scissors, ruler, pencil to write with, small bead or glue (optional).
2. Cut a square out of paper (4x4 or 6x6 inches is a good size).
3. Use a pencil and ruler to draw two diagonal lines corner-to-corner, that cross at the square's center. Mark the center point and mark a point $2\frac{3}{4}$ " from each corner on the diagonal line.
4. Cut on the diagonal line from each corner up to the marked point. Erase pencil marks, except for the center point.
5. Using the straight pin, punch a hole in the center and at every other point (about $\frac{1}{4}$ " from the tip.) Poke the pin through one of the point holes and curl the point toward the center. Don't fold! Curl each pierced point, in turn, toward the center and poke the pin through the holes.
6. Push the pin through the center hole of the pinwheel. Holding the pencil on a flat surface with one hand, push the pin into the side of the eraser.

Tip: If your pinwheel doesn't rotate freely, it is probably rubbing against the pencil. You can fix this problem by inserting the pin into the eraser at a slight upward angle, or by slipping a small bead onto the pin before inserting it into the eraser.



THE SCIENCE BEHIND IT

Most power plants, regardless of their fuel (coal, gas, nuclear power, or geothermal energy), have one similar purpose - they convert heat to electricity! Heat (energy) that comes from Earth is called geothermal energy. To understand the word geothermal, it can be broken down into its basic word parts. The word part “geo” means Earth and the word part “thermal” means heat. Geothermal energy is accessed by drilling into the Earth. At a geothermal power plant, wells are drilled 1 or 2 miles deep into the Earth to pump steam or hot water to the surface. These power plants can often be found in an area that has a lot of hot springs, geysers, or volcanic activity. All these places are where the Earth’s crust is thinner, such as Yellowstone National Park.



EXTENSIONS

- » Take the pinwheel outside. Is the air moving enough to spin the pinwheel? Wind energy is another source of energy. How does wind energy compare to geothermal energy? Why might you want to use steam to drive the pinwheel instead of wind?
- » Poke bigger holes in the aluminum foil, how does this effect the turning of the pinwheel?
- » Add a new sheet of foil and poke the holes in different locations. How does this location affect the pinwheel?
- » Poke more holes in the foil. How does this effect the turning of the pinwheel?
- » Make your own pinwheel. Does the type of paper make a difference? Does the size of the paper make a difference?

RESOURCES

- » **How a Geothermal Power Plant Works**
<https://www.energy.gov/eere/geothermal/how-geothermal-power-plant-works-simple>
- » **How to Make a Pinwheel**
<https://www.wikihow.com/Make-a-Pinwheel>
- » **Easy Pinwheel**
<https://www.auntannie.com/FridayFun/Pinwheel/>

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For information on grants, training and student opportunities, curriculum ideas and other resources, please visit **stem.inl.gov**.

