Smithsonian | SCIENCE *for Makerspaces*

ANEMOMETER ENERGY!

Anemometer Energy is tied to our Smithsonian Science for Makerspaces, and this lesson plan booklet is geared for and written to guide teachers and students in using this education tool provided by the Smithsonian Science Education Center.

Smithsonian Science for Makerspaces was developed with support from Johnson & Johnson.

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Produced by Ryan Seymour

ANEMOMETER ENERGY!

Next Generation Science Standards

3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered, to identify aspects of a model or prototype that can be improved.

Introduction

Student teams will be introduced to the phenomenon of how communities use wind energy to generate electricity. They will assess their local area for good sites to place a wind turbine. Using an anemometer, they will count the number of rotations in their chosen location. At the end of this challenge students will be able to determine strategies for optimal wind energy using 3D printed models and classroom materials.

Observe It!

Teacher will share the following passage with students

We get our energy from many different places. Some energy comes from pulling resources from the ground, like oil or natural gas. What are some other ways we can get energy? Did you know that many countries get a large part of their electricity from wind? They use a device called a wind turbine to turn motion from wind into electricity. But this system cannot work everywhere. Some places have stronger winds than others. Think of your local community. Where would be a good place for a wind turbine? Why would you place a turbine there? Where would be a bad place for a wind turbine? Do you think a wind turbine would be a good way for your community to get electricity? Why or why not?

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Make It!

Makerspace Technology and Materials

- 3D printer with filament
- 3D printer design software
- USB drive

Smithsonian Connections

To learn more about how the United States is adopting wind energy, visit Smithsonian Ocean, https://ocean.si.edu/conservation/climate-change/ocean-energy-bringing-off shore-wind-america

Teacher will print off the Anemometer Kit for each student group

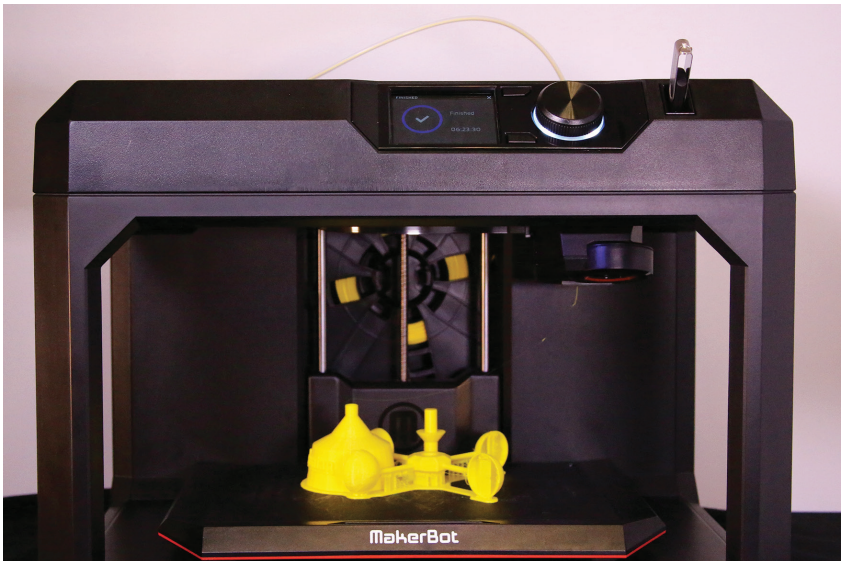
A link to the Anemometer Kit Model can be found on the resource website.

Smithsonian anemometer model dimensions: 7 x 5 x 3 inches

Steps to Print

1. Download the Smithsonian Anemometer Kit STL file.
2. Open your 3D printer design software.
3. Start a new project and Import the Smithsonian Anemometer Kit Model.
   Optional: Scale and Rotate the models as needed.
   Optional: Apply printing supports as needed.
4. Export and Open the project on your 3D printer. This may require a USB drive if your printer is not hooked up to your computer.
5. Print the models.

Approximate about ***7 hours*** of printing time for each kit.



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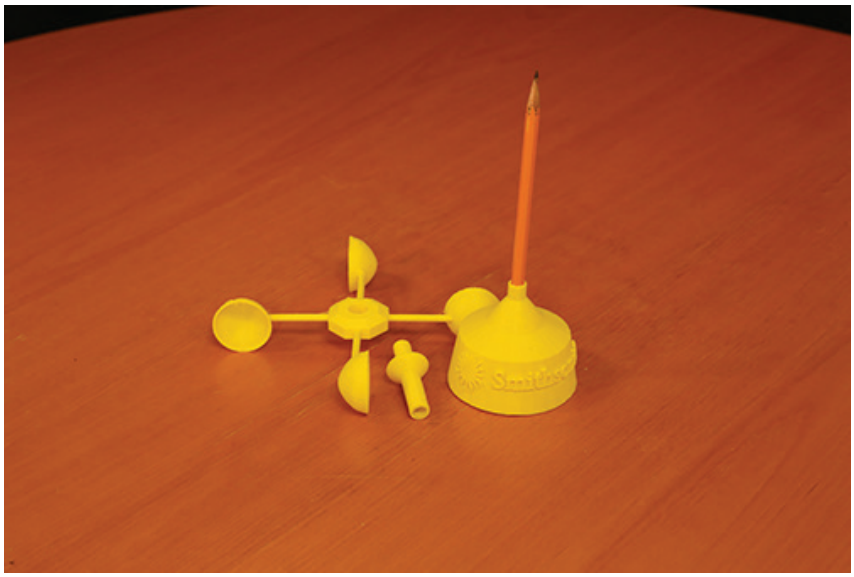
Additional Materials for Each Student Group

- 1 sharpened no. 2 pencil
- Optional: Metal washer, 1 inch in diameter



To build the anemometer, place the eraser end of the no. 2 pencil into the base unit of the model. Place the spinner piece on top of the sharpened end of the pencil. Place the anemometer cups onto of the spinner piece.

Teacher Tip: Putting a 1-inch metal washer between the spinner piece and the anemometer cups can reduce friction, allowing for more rotations.

Design It!

Students will be able to assess their local environment and point out where the best place would be to collect renewable energy

Teacher will give each student group an Anemometer Energy worksheet

The Design It! stage is separated into two sections. In Part 1, students will list where windy spots can be found in different geographic locations. Students will share their ideas in their student groups. In Part 2, student groups will explore a location selected by the teacher and map out areas they observe to be the windiest.

Design It! Part 1

- Students will list where windy spots can be found in different geographic locations.
- Teacher will ask students if they have ever seen a wind turbine or anything else that spins in the wind.
- Students will share their list with group members.

Design It! Part 2

- Student groups will go outside and map windy locations around their schoolyard.
- Students will mark local landmarks and the school building, to make as detailed a map as possible.
- Students will also mark what direction the wind was blowing at the time they visited.

Test It!

Student groups will plan out a location to assess its potential for energy collection

The Test It! stage is separated into two sections. In Part 1, student groups will record the number of rotations they observed by placing the anemometer in a windy spot for two minutes. Student groups will compare the number of rotations they observed with other groups. In Part 2, students will design adaptations to the anemometer model so it can spin even better.

Test It! Part 1

- Student groups will take their anemometer to a windy location they marked on one of their member's maps.
- Students will record how many rotations are made over 2 minutes.
- Students will have a chance to relocate or make additional adjustments to their model (for example, place it higher above the ground or change the direction of the cups).
- Students will again record how many rotations are made over 2 minutes.
- Students will add up the two numbers they recorded and return to the classroom to share their rotation numbers with the class.

Test It! Part 2

- Students will sketch out changes they would make to the anemometer to get more rotations.
- Teacher can encourage students to look at pictures of real-world wind turbines for inspiration.
- Teacher will ask, "Why were the wind turbines built like this instead of like your anemometer?"
- Students will share their sketches with the group.

Assessment Questions

What environmental changes could increase the amount of wind captured?

What are some changes to the device that could help capture more energy?

What are the challenges of using wind energy for your school?

What are some of the benefits?