Sciencenter

Revised October 2024

POWER THE FUTURE
TEACHER MATERIALS

Power the Future is an add-on educational program for your field trip to the Sciencenter. In addition to plenty of time to explore museum exhibits, a Power the Future field trip includes a hands-on engineering workshop for students facilitated by one of the Sciencenter's educators.

Program Overview

Power the Future is an NYS science standards-aligned, hands-on engineering workshop for students in grades 2-5. During the workshop portion of the program, students will collaborate with a partner to design and re-design a model turbine that can harness energy from the wind to do work. Classroom discussions will emphasize engineering as an iterative, collaborative process.

After building their turbines, students will have the opportunity to test their design at one of several "wind stations." They will then work with their partner(s) to make changes and improve their model. Finally, students will come back together as a group to reflect on their uses of various materials, the properties of their designs, and the engineering process as a whole.

NYS Science Standards Alignment

This program supports the following performance expectations:

- **K-2-ETS1-2** Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- **K-2-ETS1-3** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
- **2-PS1-2** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- **3-PS2-1** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
- **3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- **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.

This program addresses the following elements of three-dimensional science learning:

Science & Engineering Practices	Asking questions and defining problems Planning and carrying out investigations Analyzing and interpreting data
Crosscutting Concepts	Cause and effect Structure and function
Disciplinary Core Ideas	PS1.A: Structure and Properties of Matter PS2.A: Forces and Motion ETS1.A: Defining and delimiting engineering problems ETS1.B: Developing possible solutions ETS1.C: Optimizing the design solution

Planning Resources

Chaperone Guide

We encourage you to review and share the Sciencenter Field Trip Chaperone Guide, available to download here. This document contains important information about how the day of your field trip will run, and is a helpful overview of what you can expect during your visit to the museum!

Sample Field Trip Schedule

The **Sciencenter team will create and share a schedule** of lunch and workshop times for your group based on the number of classes and participants attending the field trip. This schedule, as well as additional information about getting to the museum, will be shared with you one week in advance of your trip. Here's a sample schedule to give you an idea of what to expect. If you have any questions or concerns about your group's schedule, please reach out to fieldtrips@sciencenter.org!

GROUP 1	GROUP 2
10:00 Welcome & Orientation (Connection Zone)	
10:30 Program (Classroom)	**11:15 Program** (Classroom)
11:15 Lunch (Community Room)	**12:00 Lunch** (Community Room)
12:55 Reconvene for departure (Franklin Street Entrance)	

*Schedule subject to change. A schedule will be shared 1 week in advance, and will be adjusted if needed on the day of the trip. Orientation will NOT take 30 minutes, but is scheduled to run long to minimize disruptions in the event of a late arrival.

Complementary Activities for Your Classroom

Pre-Trip Video
We recommend watching the SciGirls episode "Puppet Power" to introduce your students to the engineering process. In this episode, a group of students must build prototypes, cooperate, and improve their designs to build a large puppet for a parade.
The full episode is available to stream via PBS:
https://www.pbs.org/video/scigirls-puppet-power/

During Your Trip (Sciencenter Scavenger Hunt)
We have developed an optional Scavenger Hunt for chaperones to use while exploring the museum with your students. This tool is meant to guide student groups to different parts of the museum, and to build on the ideas presented in the Power the Future program.

Post-Trip Reflection
After your trip - either on the bus ride back to school or back in the classroom - you may find it helpful to reflect with your students on what they accomplished during the engineering workshop. The questions provided are intended to help to draw out the lesson's connections to performance expectations.

- What did you discover when you tested your very first design? How did you use what you learned to make changes to your design? (K-2-ETS1-2, K-2-ETS1-3, 3-5-ETS1-2, 3-5-ETS1-3)
- How did you use the materials to change the properties of your blades? Did you do anything to make them stronger? More flexible? A different shape? (2-PS1-2, K-2-ETS1-3)
- All of you used the same materials (paper, tape, and sticks) to make your blades, but your blades all looked very different! Do the designs have anything in common? How do the different designs affect the function of a windmill? (3-5-ETS1-2, 3-5-ETS1-3)
- People design wind turbines to solve a problem - they want to produce electricity without producing pollution. What problems can you think of that you would like to solve? What might you design or build to help solve that problem? (K-2-ETS1-1, 3-5-EST1-1)

Post-Trip Video
We recommend watching the SciGirls episode "Blowin' in the Wind" to continue the discussion with your students about wind power and renewable energy. In this episode, a group of students design and build wind turbines after seeing a need for a clean power source. They then measure the energy output of their turbine and use it to power a birdbath.
The full episode is available to stream via PBS:
https://www.pbs.org/video/scigirls-tpt-blowin-wind-full-episode/

Post-Trip Activity Suggestions
Here are two additional activities that we recommend trying in class, or sending home for students to try with their families. We would love some feedback as to which of them you used with your class, how you used it, and how it went! Send feedback and photos to fieldtrips@sciencenter.org.

Printable activity guides can be found at the end of this document.

Puff Mobile – Design a car using simple materials. Move it with only your breath!

Paper Tower – Explore ways to change the properties of newspaper while building the tallest tower you can.

CAN YOU FIND...

- ☐ A way to move something without touching it?
- ☐ A species of animal that has been affected by pollution?
- ☐ A tool that improves your natural abilities or senses?
- ☐ An activity that works best with two or more people?

Note to chaperones: This optional tool is intended to help you engage your students in meaningful interactions while you explore the museum. There is no need to complete these challenges, or to write anything down.

CAN YOU FIND...

- ☐ A way to move something without touching it?
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ZOOM into Engineering

Puff Mobile

What You Need
- 3 nonbendable, plastic drinking straws
- 4 Lifesavers™
- 1 piece of paper
- 2 paper clips
- tape
- scissors

1 Make a **car** using only the materials on the list. Here's the catch: to make your car move, you can only **blow** on it!

2 Test it out! How **far** does your car go when you **blow once**? How many puffs does it take to make the car travel **6 feet**?

Engineering Scoop

When you blow, you create **moving air**, or wind. When wind **pushes** against an object, it can make the object **move**. Think about a **sailboat**. Wind pushes against the **sail** and makes the boat move. So a sail is one part of your car that can help it move. **Wheels** can also help your car move. Maybe you have a **bike** at home. What would happen if you took the wheels off and tried to move it? (It takes a lot of force to move something that's **rubbing** along the ground.) What **other parts** did you design to help your car move?

ZOOM on

Redesign your car so that it will travel the **same** distance with **fewer** puffs. What happens if you change the **size** of the car? What happens if you use **fewer materials**? Or, what happens if you add a **new material** like thread spools? Choose one thing to change (that's the **variable**) and make a **prediction**. Then **test it** and **send** your results to ZOOM.

Sent in by Reba C. and Lee Anne F. of Medfield, MA

ZOOM INTO ENGINEERING is a partnership of WGBH and National Engineers Week. National Engineers Week 2002 chairs: DuPont and the American Society of Civil Engineers. ZOOM is produced by WGBH Boston. Funding for ZOOM is provided by the National Science Foundation, the Corporation for Public Broadcasting, the Arthur Vining Davis Foundations, and public television viewers. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

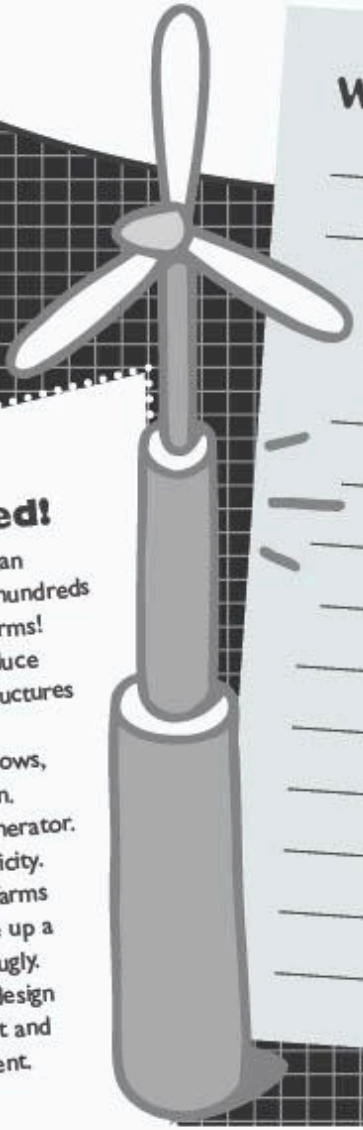
pbskids.org/zoom

Puff Mobile

Engineer's Notebook

My Prediction

What Happened



Engineers Wanted!

Wind makes your car go—it can also **make electricity** for hundreds of homes. How? With wind farms! Wind farms use wind to produce electricity. Engineers build structures called turbines that look like pinwheels. When the wind blows, the blades of the turbine spin. Then the turbine turns a generator. The generator makes electricity. Some problems with wind farms are that they are noisy, take up a lot of space, and may look ugly. Engineers like **you** could design new turbines that are quiet and blend into their environment.

Send It to ZOOM™!

Tell us about your results at

pbskids.org/zoom/sendit

Paper Tower

What's the tallest tower you can build with just 2 sheets of newspaper?

What You Need:

- 2 sheets of newspaper
- ruler

1 **Build** the tallest tower you can. You can bend, tear, crumple, or roll the newspaper.

2 Try to make the tower **taller.** Keep **redesigning** it until you can't go any higher.

3 Use the ruler to **measure the height** of your tower. It must stand for at least **30 seconds** without falling over.

Engineering Scoop

How can you make a **weak** material like newspaper **strong** enough to stand up? One way is to **change its shape**, like rolling it into a tube, crumpling it, or pleating it with folds. You also need to think about the different **forces** that are acting on it. The tower's **weight** is pulling the tower down. The **surface** on which the tower is resting is pushing back up. Small **air movements** are also pushing from the side and can blow the tower over. If you build a **wide base** at the bottom, this distributes the weight over a wider area and makes the tower more **stable**.

ZOOM on

How can you make your tower even **taller**? What happens if you add 20 cm (about 8 in.) of **tape**? What happens if you use **books** as a foundation to support the bottom of the structure? Or, what happens if you use a different type of **paper**, like tissue paper, copier paper, or cardboard? Choose one thing to change (that's the **variable**) and make a **prediction**. Then **test it** and **send** your results to ZOOM.

Sent in by Jen W. of Maple Springs, NY

ZOOM into Engineering is a partnership of WGBH and National Engineers Week. Funding for ZOOM into Engineering is provided by National Engineers Week and its 2002 chairs: DuPont and the American Society of Civil Engineers. ZOOM is produced by WGBH Boston. Funding for ZOOM is provided by the National Science Foundation, the Corporation for Public Broadcasting, and public television viewers. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. Illustrations by Stephen Schudlich.

PBS KIDS

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Paper Tower

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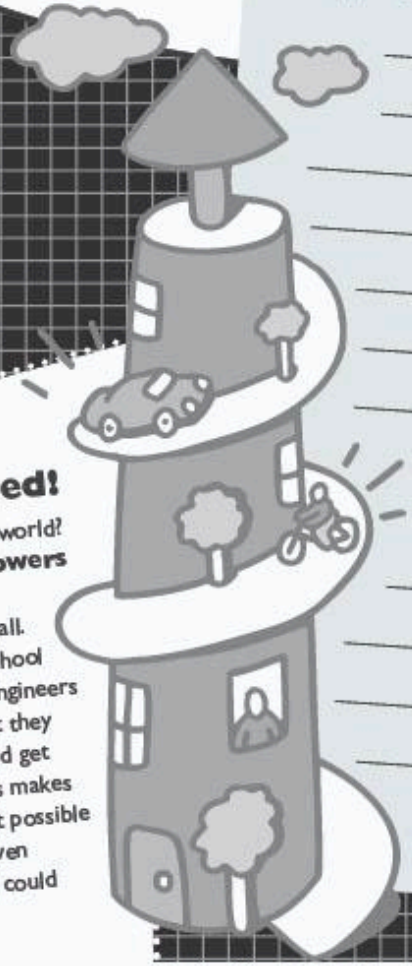

Engineers Wanted!

What's tallest building in the world? So far, it's the **Petronas Towers** in Malaysia. These matching towers are both 1,483 feet tall. (That's about as tall as 42 school buses placed end to end.) Engineers designed the towers so that they are wider at the bottom and get narrower near the top. This makes the towers very stable. Is it possible to make a building that's even taller? Engineers like **you** could make it happen!

Send It to ZOOM™!

Tell us about your results at

pbskids.org/zoom/sendit