WIND ENERGY

STEM CHALLENGE

BACKGROUND:

After watching the *Renewable Energy on a Grain Farm* video, students will be ready to explore a source of renewable energy on farms – wind turbines. These are complicated and very technical mechanisms but we can make simple examples with common objects.

CHALLENGE:

Create a simple model of a wind turbine to show how differences in the shape of the blades affects how the blades spin.

RECCOMENDED MATERIALS:

You could use purchased pinwheels for this activity, but the results will probably not be as extensive.

- Paper or cardstock, uncut or precut into 18 cm squares (several for each group)
- Pencil or pen
- Round skewers
- Scissors
- Blow-dryer (to create wind)
- Optional: fan that oscillates
- Notebook or paper for recording results

PROJECT STEPS:

CREATE

Students will use the Engineering Design Process to plan and build a wind turbine and explore the effects of the turbine's shape on capturing wind.
Observations:

How much or how little wind is required?

How well does a turbine spin based on wind direction?

TEST & IMPROVE

Students will try it out!

Does it work the way they want it to?

How can they make it even better?

SHARE

Students will describe how their wind turbine works depending on the shape of its blades

ONTARIO CURRICULUM LINKS:

Grade 5: Science and Technology – Exploring and Understanding Concepts, Conservation of Energy and Resources
E2.1, E2.2, E2.3, E2.4, E2.5, E2.6

Grade 6: Science and Technology – Electrical Phenomena, Energy, and Devices
C1.1, C1.2

ADDITIONAL RESOURCES:

Engineering Design Process: https://goodineverygrain.ca/wp-content/uploads/2025/04/Engineering_infographic.pdf

Real Dirt on Farming (page 31): https://publuu.com/flip-book/319289/736970/page/1

Renewable Energy on a Grain Farm: https://youtu.be/pxxGn-1Fys4

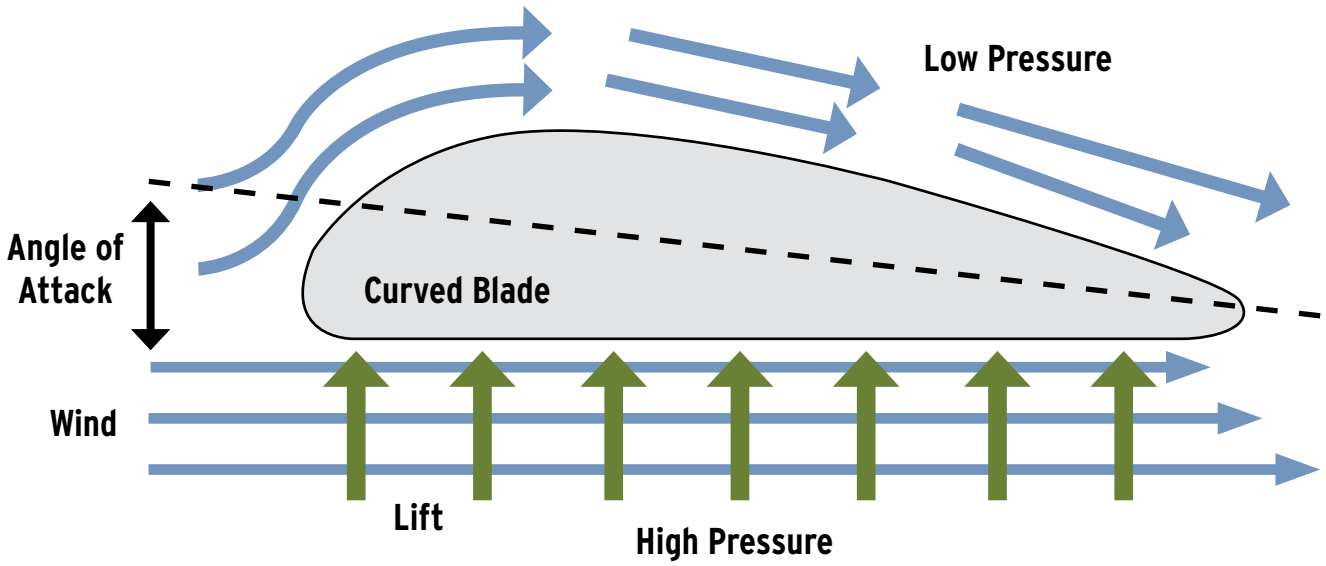
LESSON PLAN DETAILS FOR EDUCATORS

STEM CHALLENGE

BACKGROUND:

Wind turbine blades are much like airplane wings; they have an airfoil shape. If you were to look at the cross section of a wing from its tip moving toward the airplane body, it would be almost almond-shaped, thicker at the leading edge (front) and tapering back. As wind moves across this shape (angle of attack), it creates lift, which keeps the airplanes in the air and makes wind turbine blades turn.

Curved Blade Air Flow And Performance



For more detail and some of the physics involved:

Wind Turbine Blade Design, Flat, Bent or Curved

Energy 101: Wind Power (3:16)

How wind turbines work with good explanation of how blade shape affects turbine operation. (American references)

Visit A Giant Wind Turbine on a Wind Farm! (5:19)

Visiting a wind turbine in the Niagara region. See how the turbine is built and how the nacelle and blades are installed, showing how huge a wind turbine is. Presents a model of a turbine with the shape of the blades evident. Explains how the electricity gets from the turbine to homes and businesses.

TEACHING:

Divide the class into groups and instruct them to work together to plan and build a series of wind turbines with differently shaped blades. If time allows, you may wish to have students create a written plan for their design.

Lesson Instructions

- Show students one or both videos to explain how wind turbines work to capture wind and generate electricity.
    - Energy 101: Wind Power (3:16)
    - Visit A Giant Wind Turbine on a Wind Farm! (5:19)
- Review the Science and Engineering Principles and the Engineering Design Process with students.
- Challenge students to create a wind turbine using the materials provided to determine which shape of blades turn best to produce electricity.
- Have students use Science and Engineering Principles and the Engineering Design Process to hypothesize what makes a wind turbine more powerful and test their hypotheses with the activity.

How to make a pinwheel

(Instructions are from Scientific American)

- Cut a sheet of paper so that it is a square (18 cm x 18 cm).
- Fold the square of paper along the diagonal, then unfold it back into a square again.
- Fold it along the other diagonal, and then unfold it once again. Your paper should now look like a square with a big "X" made by the creases.
- About 5 cm out from the center, along each crease, make a small mark with a pen or pencil. See diagram below.
- Carefully make four holes with a skewer to the right of each crease near the square's corners and a hole in the paper's center.
- From each corner of the square, cut down along the crease until you reach the mark you made.
- Lastly, pick up each of the holes at the corners and fold them, one at a time, over onto the skewer, so that they are all on top of one another. You should now have a functional, homemade pinwheel!
- To make additional pinwheels with different blades, pinch the curved sides of a pinwheel made just like the first one; draw the corner dots further down the crease to shorten the length of the "blade"; use a smaller square of paper to begin. OR create your own idea of a wind turbine!

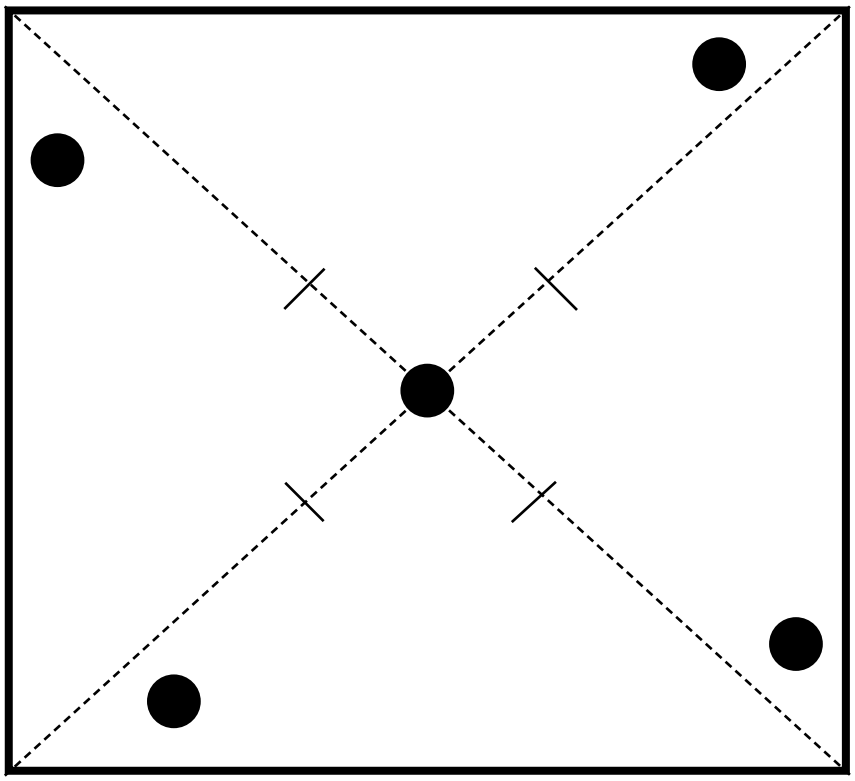


Image Credit: Kristin Strong, Science Buddies / Science Buddies

DESIGN, BUILD AND TEST YOUR TURBINE

- Remember that you are trying to determine which shape of turbine blade turns best.
- Use the pinwheel design or create your own plan to imagine solutions.
- What's your plan? Write down the steps and materials.
- Create your wind turbine and test it.
    - For each test, record your observations of how fast the turbine spins in each case: barely moves; spins slowly; spins so fast we can't even see it!
    - Apply different levels of "wind" to the front of your turbine by blowing on it with your breath, holding a hair dryer in front of it—use low and high speeds, and if possible, hold your turbine in front of a fan.
    - Note which way the blades spin—clockwise or counter-clockwise.
    - Turn the turbine so its front is facing to your right. Apply the wind to the bottom half of the blades and then to the top half. Does it spin differently?
    - How else can you test your turbine?
- Discuss your results with your group. Talk about what worked best and how to improve the design.
- Present your results.

CONSOLIDATION & ASSESSMENT:

Questions for discussion or research assignments.

1. Nothing exists without affecting something else. Fossil fuels are a perfect example. When people learned how to use fossil fuels to create usable energy, they did not realize that their new energy would harm the Earth. After all, humans are small, and the Earth is huge. Consider the infrastructure for capturing renewable energy—what does it take to create a wind turbine or a solar panel? Think about all the components and how they are obtained, such as steel and copper, which are mined and melted, the cement required to make their bases, and the lithium mined to make rechargeable batteries. **What are the environmental costs of establishing renewable energy?**

2. **Which renewable energy source is the best?** The answer to this question may be "It depends." There are many variables to consider, such as geography, climate, available resources, impact on the local region where the energy source is to be harvested. There is no one size that fits all solution when it comes to energy. **What about the transportation to take the components and completed objects to their destinations? What about environmental costs to establish that renewable energy source?**

Assessment Quiz - Download