Building a Wind Turbine

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Target Grade: 6-8 Grade

Time Required: 6 days, 45 minutes a day

Standards:

- MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system
- HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
- RHST.6–8.4: Determine the meaning of symbols, key terms, and other domain-specific works and phrases as they are used in a specific scientific or technical context relevant to Grades 6–8 text and topics.

Lesson Objectives:

Students will:

- Design a wind turbine
- Create movement using a renewable resource
- Construct blades that move the axle with the wind

Central Focus:

Students will be building a wind turbine under a few constraints. They will first research the different types of turbines (vertical vs horizontal) and then continue to look at designs online. Using their ideas, and what they know, they are presented with a goal of having their wind turbines (powered using a fan to replicate wind) lift up 10 pennies.

Background Information:

Students have finished exploring the world of alternative energy and how these methods could minimize the amount of nonrenewable resources we use. These young scientists have explored how the use of fossil fuels can harm the world around us. We are exploring various ways we can use natural resources/renewable resources to power our everyday things. We explored solar energy, wind energy, and biofuels.

Materials

- Wind turbine Packets
- Turbine materials (this can vary, but some are listed on the turbine packet already)
- iPad/laptops

Instruction

Day 1

Introduction

Present Challenge: Create wind turbines that can life up a contraption of at least 10 pennies. Note competitive nature, "The group with the most number of pennies get bragging rights!".

Step 1: Tell students they will be engineers that design a wind turbine, but only have sponsors from one company who are giving them $20 dollars. They are also only allowed to shop in the "classroom's store"—no other stores allowed.

Step 3: Pull up pictures of different turbines and begin researching the difference between horizontal and vertical axle turbines.

Day 2

Introduction

Step 1: Show students all the materials that will be used & explain to them their price limit of $20. Each student will be given $20 and if they lose it, it will be lost forever. So, remind them to be responsible.

Activity

Step 2: Students should be planning their designs on page 3 of the packet that asks for a detailed diagram and explanation of their design using the science terminology.

Day 3

Step 1: Finish planning and open school store for students to "purchase" the supplies needed for their models. Make the fan readily available for all students.

Day 4 and 5

Step 1: Today the groups will build their wind turbine. Make sure the students have access to the fan.

Testing day

Students will test their turbines with the pennies. Allow students to rebuild if needed.

Differentiation

In this lesson the teacher will verbally and instructionally scaffold. The grouping will be flexible to allow students to engage with another. A graphic organizer will be used to help separate data.

Assessment

Formative

Students will be assessed through teacher observation and discussion. Students will be grades on their notebook/journal and oral defense. See materials page for reflection questions for journal.

Name:

Introduction: Alternative energy has been a hot topic in the last few years. We have seen more and more wind turbines and wind farms implemented to shift our main use of energy from nonrenewable sources to renewable sources of energy.

> A **nonrenewable source** of energy is energy that we cannot make more of. There is a certain amount of this type of energy, and once it is depleted, there is not a way to create more for our use.
>
> *Examples of nonrenewable sources of energy include coal, natural gas, and oil.*
>
> A **renewable source** of energy is energy that we can easily get more of. We can either create more within our lifetime or there is constantly more around.
>
> *Examples of renewable sources of energy include sun, wind, water current, biomass (living energy like wood), etc.*

Problem: Most of our energy consumption today comes from nonrenewable sources. For example, we fill our cars up with oil. Most of our electricity comes from coal. This is a problem because there will be a point when **we run out** of these nonrenewable sources.

Solution: Therefore, we have to start becoming creative and shift our energy sources to renewable sources. One idea that is very popular is wind turbines. Wind turbines have many different shapes and sizes.

Your Task: You are going to design a wind turbine that will lift at least 10 pennies off the ground with only the power from wind. The pennies must be lifted at least 30 cm from the ground. Before you design the wind turbine, you should know some of the limitations of your wind turbine design. Your wind source will be a box fan. You can position the wind turbine at any angle or distance from the box fan. You have a budget of twenty dollars and you can only use the materials presented on the following pages.

Research: The first job of a designer is to research designs that you think will work best. On the back of this page, there is a graphic organizer set up to help you conduct your research.

Wind Turbine Research

There are two types of wind turbines: **a vertical axis** turbine and **a horizontal axis** turbine. Research each type and draw some pictures of each in the boxes below.

Vertical Axis Turbines (Draw at least 2)	Horizontal Axis Turbines (Draw at least 2)

What are some advantages of a horizontal axis wind turbine?

What are some disadvantages of a horizontal axis wind turbine?

What are some advantages of a vertical axis wind turbine?

What are some disadvantages of a vertical axis wind turbine?

Planning

Constraints: You have $20 to spend. On the right is a table of the supplies and their cost. Also, remember that your only wind source is a box fan.

With your partner, discuss whether you want to construct a horizontal or a vertical axis turbine. Write a paragraph below explaining why you think the type of axis you chose is the best for your turbine. You must give at least 3 reasons. Underline your reasons in your paragraph.

Material	Price
Popsicle Stick	$1.00
Rubber Band	$1.00
Straw	$1.00
Styrofoam Block	$1.00
String	$1.00/30cm
Dixie Cup	$1.50
Cardstock	$1
Bamboo Skewers	$1
Tape	$1.00/30 cm

Draw a picture below what you want your turbine to look like. Label the supplies that are used. Make sure that this picture is detailed! It doesn't have to look like the work of Michelangelo, but I need to be able to tell exactly how you plan to construct it.

Material	Price	Quantity	Total Price

Total Price:

Rubric

Wind Turbine Structure	10 – Wind turbine is constructed, and blades turn in wind.	5 – Wind turbine is constructed, but blades do not turn.	0 – Wind turbine is not constructed.
Number of Pennies	20 – Can lift at least 10 pennies 30 centimeters off the ground	10 – Can lift at least 5 pennies 30 centimeters off the ground	0 –Lifts less than 5 pennies 30 centimeters off the ground

Applying Scientific Principles to your Wind Turbine

Introduction: Like all designs, only one variable can be changed at a time. You are going to change one variable on your wind turbine. List all of the possible variables that you could change: (Example: blade height)

_____

_____

_____

_____

Circle the variable that you want to test. When you change the variable, you must run several tests on the new variable. One test is not very reliable because something odd may have happened during that test. Testing a variable multiple time makes sure that the data is reliable. You must also test it the old way multiple times to see how the new variable compares to the old one. Therefore, you can clearly see which variable will give the most desired results. For example, if you are changing blade height, you need to test the blades at your initial size. Let's say your initial size was 15 cm. You are going to test how many pennies the blades at 15cm can lift at five times. Then, you are going to change the blades to 25 cm. You are going to test how many pennies the blades at 15cm can lift at five times. If you have more data, you will have more reliable results.

Now, **explain** how you are going to change that variable. (For example, I would change the blade height by having two different sizes of blades. One set of blades will be 15cm, and the next set of blades will be 25 cm.

Finally, you are test your variable with the pennies. Then, fill out the data table

Changes	Number of Pennies that were lifted 30 cm
Change #1: *(Ex. 15 cm blades)*	
Change #2: *(Ex. 25 cm blades)*	

Now, choose another variable that you like to test. Write that variable below.

Explain how you are going to change that variable.

Changes	Number of Pennies that were lifted 30 cm
Change #1: *(Ex. 15 cm blades)*	
Change #2: *(Ex. 25 cm blades)*	

Alternative Energy Questions

1. Why is wind energy a better alternative than energy from fossils fuels (coal, natural gas)?

2. What was your most difficult challenge when trying to create a wind turbine to lift the greatest number of pennies?

3. What did you do to overcome this challenge?

4. From your knowledge that you now have about wind turbines, what would happen if you had too much wind?

5. From your knowledge about wind turbines, what would happen if you had too little wind?

6. From your knowledge about wind turbines, what would happen if your wind turbine was not in the direction of the wind?

7. From your knowledge about wind turbines, what would happen if your wind turbine was very low to the ground?

Packet Points:___/20