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Wind Turbine Design Worksheet Answer Key

You will be engineering blades for a wind turbine to provide power to a research station on a remote island. You will then test your turbine using a multimeter to see how much power is generated. Once all groups have finished testing, teams will evaluate and modify their designs.

1. Introduction

From what does wind get its energy? __The wind gets its energy from the sun._____

Wind turbines convert ____kinetic_____ energy into _____electrical_____ energy.

List two things you notice about the design detail changes of wind turbines through history.

1. _The materials change, the blades get larger, the number of blades change, etc._____
2. _____

2. Design

Draw your blade design below. (All of your blades should be identical.)

Use scientific terms to describe why you think your design will work.

_____

_____

_____

_____

3. Construction

1. Decide how many blades you want in the turbine.
2. Trace on cardboard the shape of your turbine blades.
3. Use scissors to cut the cardboard.
4. Use masking tape to attach the blades to wooden dowels.
5. Test your blades on the wind turbine.
6. Record your data and add it to the class chart.
7. Copy into your table other teams' results as they are added to the class chart.

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8. Discuss with your group how you can improve your blade design based on how your blades worked.

Blade Design	# of Blades	Blade Angle	Power Produced
Group 1			
Group 2			
Group 3			
Group 4			
Group 5			
Group 6			
Group 7			
Group 8			

4. Evaluation

How much power do the scientists need? Did your turbine produce enough power for the entire research station? If not, how many turbines would you need? Complete this section to determine how your turbine design would provide power for the scientists.

Determine **power** by multiplying **voltage** by **current**:

power (watts)	=	**voltage** (volts)	x	**current** (amps)
1 watt [W]	=	1 Volt [V]	x	amp [A]
1 milliwatt [mW]	=	1 Volt [V]	x	1 milliamp [mA]

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Practice Problems

1. A wind turbine produces 1 volt of voltage and 15 milliamps of current. How much power did it produce? Show your work.

$$\text{power} = \text{voltage x current} = 1 \text{ volt} \times 15 \text{ milliamps} = 15 \text{ milliwatts} = 15 \text{ mW}$$

2. A wind turbine produces 2 volts of voltage and 10 milliamps of current. How much power did it produce? Show your work.

$$\text{power} = \text{voltage x current} = 2 \text{ volt} \times 10 \text{ milliamps} = 20 \text{ milliwatts} = 20 \text{ mW}$$

Different devices use different amounts of power. Pick ***2 items*** from the table below and calculate how many of your wind turbines you would need to power each item. (Remember, 1 watt = 1,000 milliwatts).

Device	Power Required
Smartphone	2 watts
Light bulb	50 watts
Laptop computer	25 watts
Stereo	5 watts

Complete each statement (round to the nearest whole turbine):

3. I would need ___*133*_____ of my turbines to power a __*smartphone*_____.
   If my turbine produces 15 milliwatts of power, then

$$\frac{2 \cancel{watts}}{smartphone} x \frac{turbine}{15 \cancel{milliwatts}} x \frac{1000 \cancel{milliwatts}}{\cancel{watt}} = 133 \; turbines \; per \; smartphone$$

4. I would need ____*3333*_____ of my turbines to power a __*light bulb*_____.
   If my turbine produces 15 milliwatts of power, then

$$\frac{50 \cancel{watts}}{light \; bulb} x \frac{turbine}{15 \cancel{milliwatts}} x \frac{1000 \cancel{milliwatts}}{\cancel{watt}} = 3333 \; turbines \; per \; smartphone$$

<u>Ultimate Question—Round 1</u>

The scientists have 5 smartphones, 3 laptops, 10 lightbulbs and 1 stereo that they want to use. How much power does it take to run all of them at the same time? How many of your turbines would you need to power all of them?

$$5 \; smartphones \; x \; \frac{2 \; watts}{smartphone} = 10 \; watts$$
$$+ \; 3 \; laptops \; x \; \frac{25 \; watts}{laptop} = 75 \; watts$$
$$+ \; 10 \; light \; bulbs \; x \; \frac{50 \; watts}{lightbulb} = 500 \; watts$$
$$+ \; 1 \; stereo \; x \; \frac{5 \; watts}{stereo} = 5 \; watts$$

590 watts total

$$590 \; W \; x \; \frac{turbine}{15 \; mW} x \frac{1000 mW}{W} = 39{,}333 \; turbines$$

example answers

I would need ___*39,333*___ of my turbines to generate __*590 watts*__ of power for all of the devices.

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5. Redesign

Choose **one** variable to change from your original design and write it down below. Consider alterations to the blade design, number of blades or blade angle.

I am going to change the _____.

Draw your blade design below. If you are testing a different variable, draw the original design.

If you are changing your blade design, use scientific terms to explain why you think your new design will work better than the first design. If not, explain why you are keeping the same design.

_____

_____

_____

_____

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6. Re-Evaluation

1. If you are changing the blade angle, decide on two other angles you want to test.
2. If you are changing the blade design or increasing the number of blades, follow steps 1-4 in Part 3 to build your new blades.
3. Test your blades on the wind turbine.
4. Record your data in your table and add it to the class chart.

Blade Design	# of Blades	Blade Angle	Power Produced
Group 1			
Group 2			
Group 3			
Group 4			
Group 5			
Group 6			
Group 7			
Group 8			

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Ultimate Question—Round 2

The scientists have 5 smartphones, 3 laptops, 10 lightbulbs and 1 stereo that they want to use. How much power does it take to run all of them at the same time? How many of your redesigned turbines would you need to power all of them?

I would need _____ of my turbines to generate _____ power for all of the devices.