Group Color: _____
Subgroup Number: _____

How Science Works

Grade 4

Module 2

Class Question:

Scientist (Your Name): _____

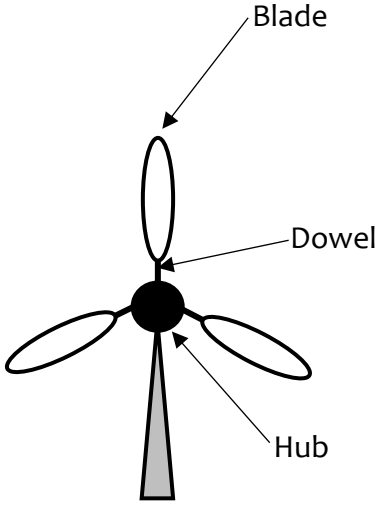
Teacher's Name: _____

SciTrek Volunteer's Name: _____

VOCABULARY

Science: The study of the material world using human reason. The scientific method is the way humans reason and apply logic to data to help gain knowledge of the world.

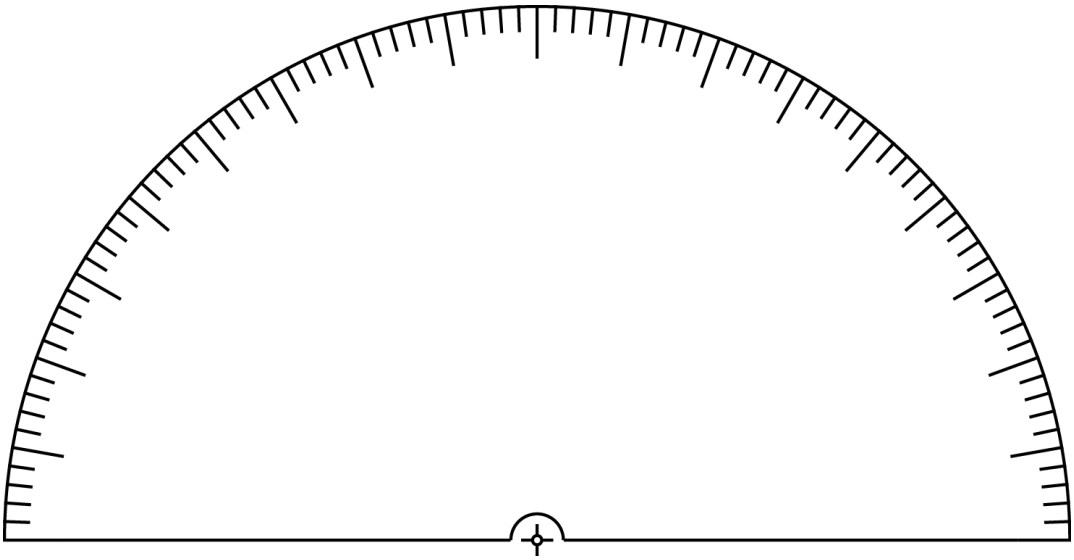
- **Observation:** A description using your five senses. This could include contents, mass, size, color, temperature, smell, texture …
- **Opinion:** Something you believe or feel. Not a fact or observation.
- **Inference:** A guess based on past experiences.
- **Testable Question:** A question for which an experiment can be designed to answer.
- **Non-Testable Question:** A question for which an experiment cannot be designed to answer. For example, questions involving things that cannot be measured/observed or things that are not well defined/opinions.
- **Experimental Set-Up:** The materials, changing variable, and controls that are needed for an experiment.
- **Experiment:** A test or trial to discover something unknown**.**
- **Procedure:** A set of steps to conduct an experiment.
- **Controls:** The variables that are not changed in an experiment.
- **Changing Variable (Independent Variable):** The variable that is purposely changed in an experiment.
- **Results/Data (Dependent Variable):** The measurements/observations of the experiment, which are influenced/determined by the changing variable.
- **Prediction:** What you expect to happen based off of previous measurements/observations.
- **Scientific Practices:** A series of activities that scientists participate in to both understand the world around them and to communicate their results with others. (The specific practice worked on in this module is procedures.)
- **Technique:** A method for a specific task.
- **Angle:** A measurement telling the separation between two lines that meet at one point.
- **Multimeter:** A tool used to measure voltage, current, or resistance. For this module we will use it to measure the current the wind turbine produces.
- **Current:** A measure of the amount of electricity flowing.
- **Milliamp (mA):** The units that current is measured in.
- **Protractor:** A device used to measure angles.
- **Wind Turbine:** A large "fan like" machine that rotates by wind to generate electricity.
- **Blade:** A long circular piece that is attached to the hub of a wind turbine to guide the wind flow.
- **Hub:** The center part of a wind turbine in which the blades are attached.
- **Dowel:** A wooden piece that attaches to the blade so that the blade can be connected to the hub.
- **Energy:** The ability of an object to do work. Energy can be transferred but it cannot be created or destroyed.
- **Engineering:** A branch of science that focuses on designing, building, modifying, and constructing objects and machines.



Wind Turbine

TECHNIQUE
Protractors

Protractors are used to measure and draw angles.

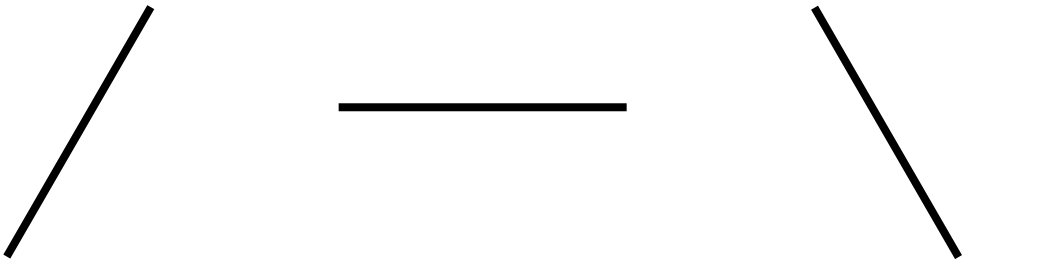


1. Label the following angles on the protractor above:

   a. 0° b. 90° c. 180° d. 150°

2. The following lines have an angle of 0°/180°, 60°, or 120°. Label each line with the corresponding angle value.

   a. b. c.

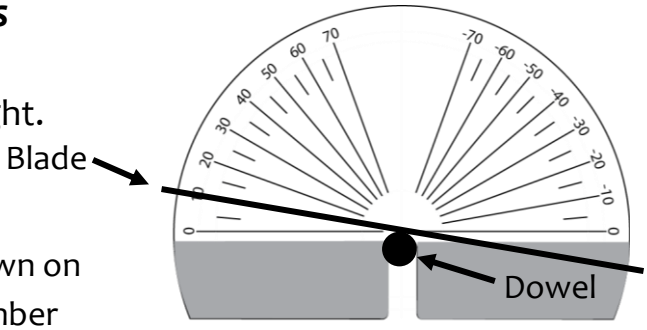


   _____ _____ _____

3. What do you notice about the 120° and 60° angles?_____

   _____

TECHNIQUE
Protractors



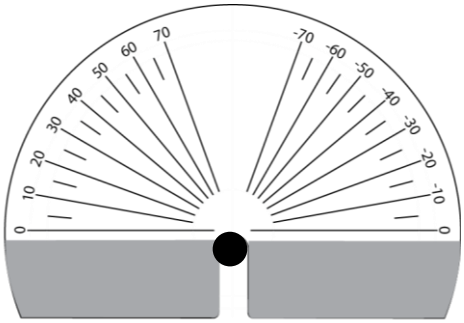
Label 0°, 90°, and 180° on the protractor to the right.

How to find angles between 90° and 180°:

For angles greater than 90°, take the number shown on the wind turbine protractor and subtract that number from 180°.

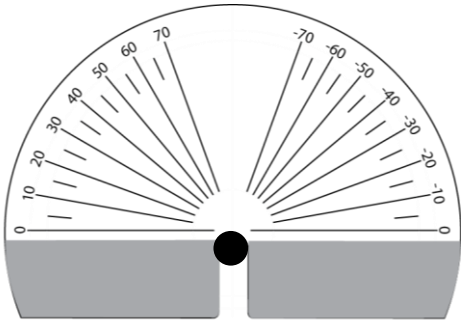
Draw the wind turbine blade at the specified angle.

1.



Angle: 30°

2.



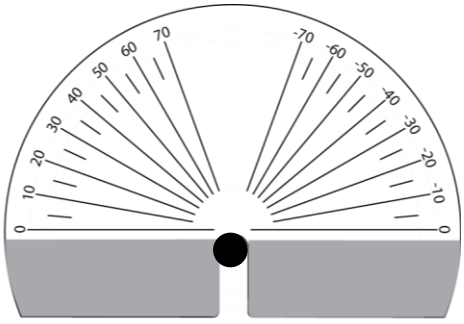
Angle: -20°
This angle is also referred to as:

180°

-

_____

3.



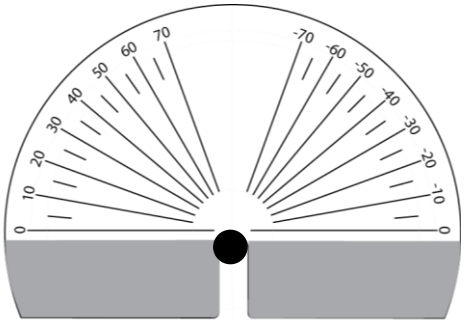
Angle: -70°
This angle is also referred to as:

180°

-

_____

4.



Angle: 150°
This angle is shown as:

180°

-

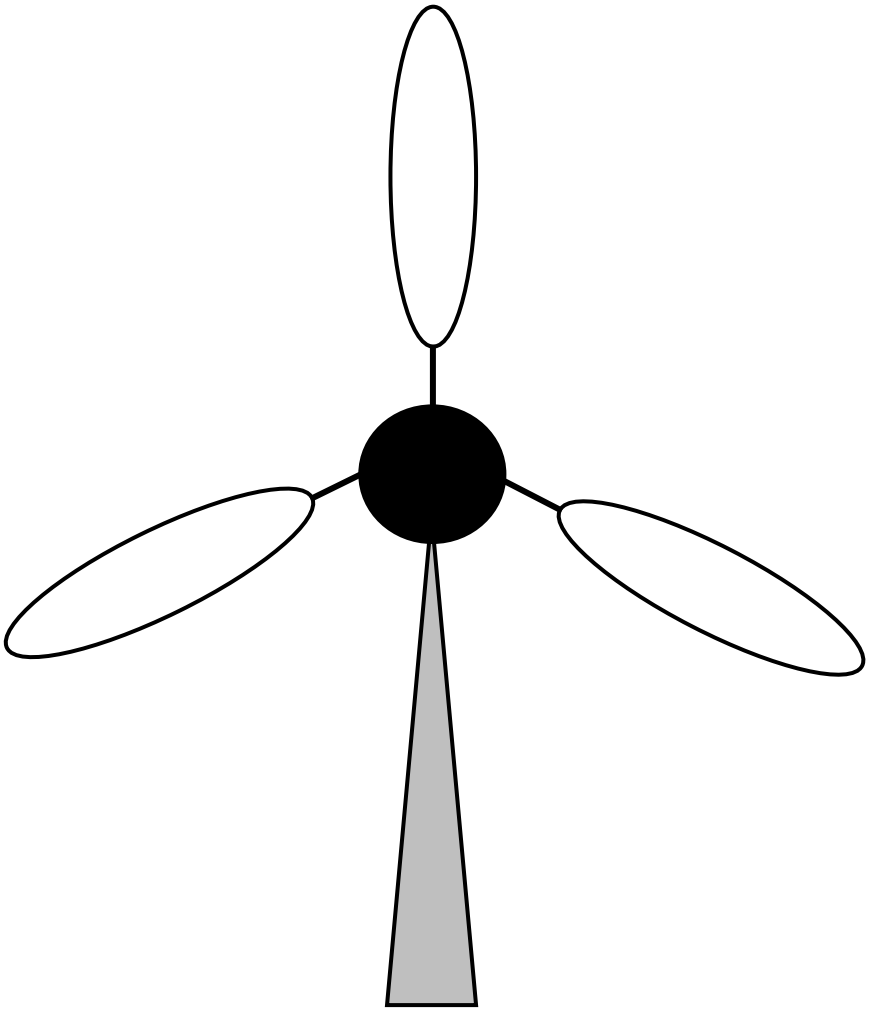
_____

150°

OBSERVATIONS

Experimental Set-Up:

On the picture below, indicate relevant dimensions of the wind turbine.



Other aspects of the experimental set-up:

_____

_____

_____

_____

_____

_____

OBSERVATIONS

	Cardstock Blades	Cardboard Blades
Current (mA):		
Similarities:		
Differences:		

Other Observations:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

VARIABLES

Variable	How will changing this variable affect the current?
	_____ _____ _____
	_____ _____ _____
	_____ _____ _____
	_____ _____ _____
	_____ _____ _____

Experimental Considerations:

1. You will only have access to the materials on the materials page.
2. See the materials page for restrictions on experimental design.
3. When you start the fan, the wind turbine must be still, and you may not push it.
4. When recording currents, wait until the wind turbine gets up to speed. Then, watch the multimeter for approximately 15 seconds, and record the number you see most often.

Changing Variable (Independent Variable): _____

Discuss with your subgroup how you think your changing variable will affect the current produced by the wind turbine.

QUESTION

Question our subgroup will investigate:

- If we change the _____,
  insert changing variable (independent variable)

  what will happen to the _____
  insert what you are measuring/observing (dependent variable)

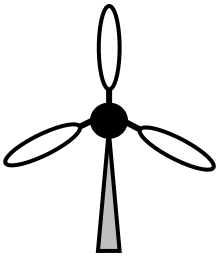
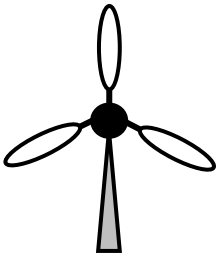
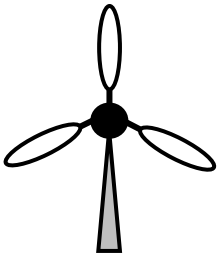
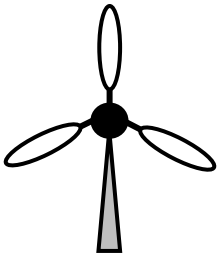
  _____?

SciTrek Member Approval: _____

Get a materials page from your SciTrek volunteer and fill it out before moving onto the experimental set-up.

EXPERIMENTAL SET-UP

Write your changing variable (Ex: blade number) and the values (Ex: 4) you will use for your trials under each wind turbine.

	Trial A	Trial B	Trial C	Trial D
				
Changing Variable:				
:				

Controls (variables you will hold constant)**:**
Write the controls and the values you will use in all your trials (control/value, Ex: blade material/cardstock).

Blade Material / Cardstock	/
/	/
/	/
/	

SciTrek Member Approval: _____

PROCEDURE

1. _____

_____

_____

2. _____

_____

_____

3. _____

_____

_____

4. _____

_____

_____

5. _____

_____

_____

6. _____

_____

_____

In your procedure underline controls, circle changing variables, and box data collection.

SCIENTIFIC PRACTICES

Procedures

Directions: Fill in the missing definition.

- **Procedure:**_____

  _____

A complete procedure MUST have:

- All values of the _____,and the

  _____.

- The _____ that will be collected

  (measurements/observations).

- The steps listed in the order they will be completed.

A complete procedure MUST <u>NEVER</u> have:

- _____, or irrelevant information.
- _____about the experiment.
- _____values of controls, or the changing variable.

SCIENTIFIC PRACTICES

Procedures

QUESTION

If we change the popcorn brand, what will happen to the number of kernels that pop?

EXPERIMENTAL SET-UP

Changing Variable:	Trial A	Trial B	Trial C	Trial D
Popcorn Brand:	Pop Secret	Orville	Smart Balance	Act II

Controls (variables you will hold constant)**:**

Microwave Level / High	Popcorn Color / Yellow
Time / 3 Minutes	Salt Amount / 220 mg
Container Type / Bag	Initial Number of Kernels / 200

Directions:

Step 1: Read each statement and underline <u>controls</u>, circle changing variables, and box information about data collection.

Step 2: Circle yes if the statement could be a correct step for a procedure about the question and experimental set-up above. If not, circle no.

		Could this be a procedure step?	
1.	Put the bag in the microwave on high for 3 minutes.	*Yes*	*No*
2.	Get 200 kernels of yellow A) Pop Secret, B) Orville, C) Smart Balance, D) Act II popcorn.	*Yes*	*No*
3.	Observe what happens.	*Yes*	*No*
4.	Put 200 kernels of yellow Pop Secret popcorn and 220 mg of salt in bag A.	*Yes*	*No*
5.	Get 200 kernels of different yellow popcorn brands.	*Yes*	*No*
5.	Count the number of kernels that have popped in each bag.	*Yes*	*No*
6.	Put the tasty popcorn in the microwave on high for 3 minutes.	*Yes*	*No*

Underline <u>controls</u>, circle changing variables, and box data collection.

SCIENTIFIC PRACTICES
Procedures

Directions: Read the following procedure that is based on the question and experimental set-up on page 11 and underline controls, circle changing variables, and box data collection. If any controls are missing or incorrect, add the correct values to the procedure. Remove any extra or irrelevant information from the procedure by crossing it out. If any steps are out of order, draw an arrow (↔) to indicate the correct order.

PROCEDURE

1. Get 200 kernels of yellow A) Pop Secret, B) Orville, C) Smart Balance, D) Act II popcorn.
2. Put each bag in the microwave on high.
3. Put the popcorn and 250 mg of salt into four separate bags.
4. Count the number of kernels that popped in each bag.
5. Eat the popcorn.
6. Have fun.

SCIENTIFIC PRACTICES

Procedures

Directions: Read the following procedure and underline controls, circle changing variables, and box information about data collection.

PROCEDURE

1. Hang a 50 cm string.

2. Attach a metal ball with a mass of A) 20 g, B) 30 g, C) 40 g and circumference of 20 cm to the string.

3. Pull ball back 30 cm from resting point and drop.

4. Measure the time it takes the balls to complete one swing.

RESULTS

Table

Fill out the table for each of your trials. For the variables that remain constant, write the value in *Trial A*. Then, draw an arrow through each box indicating the variable is a control.

Underline controls, circle changing variables, and box information about data collection.

Variables		Trial A	Trial B	Trial C	Trial D
Blade Material:		***Cardstock*** →			
Blade Number:					
Weight Number:					
Weight Placement:					
Dowel Placement:					
Blade Angle: (list both the actual angle and what angle you will find on the wind turbine protractor)					
Fan Distance:					
_____ Other Variable					
Predictions		**Trial A**	**Trial B**	**Trial C**	**Trial D**
Put an "L" in the trial that will give the least current and an "M" in the trial that will give the most current.					
Data		**Trial A**	**Trial B**	**Trial C**	**Trial D**
Measurements:	Current:				
Observation:	Other:				

The independent variable is the changing variable and
the dependent variables are the final measurements/observations.

RESULTS

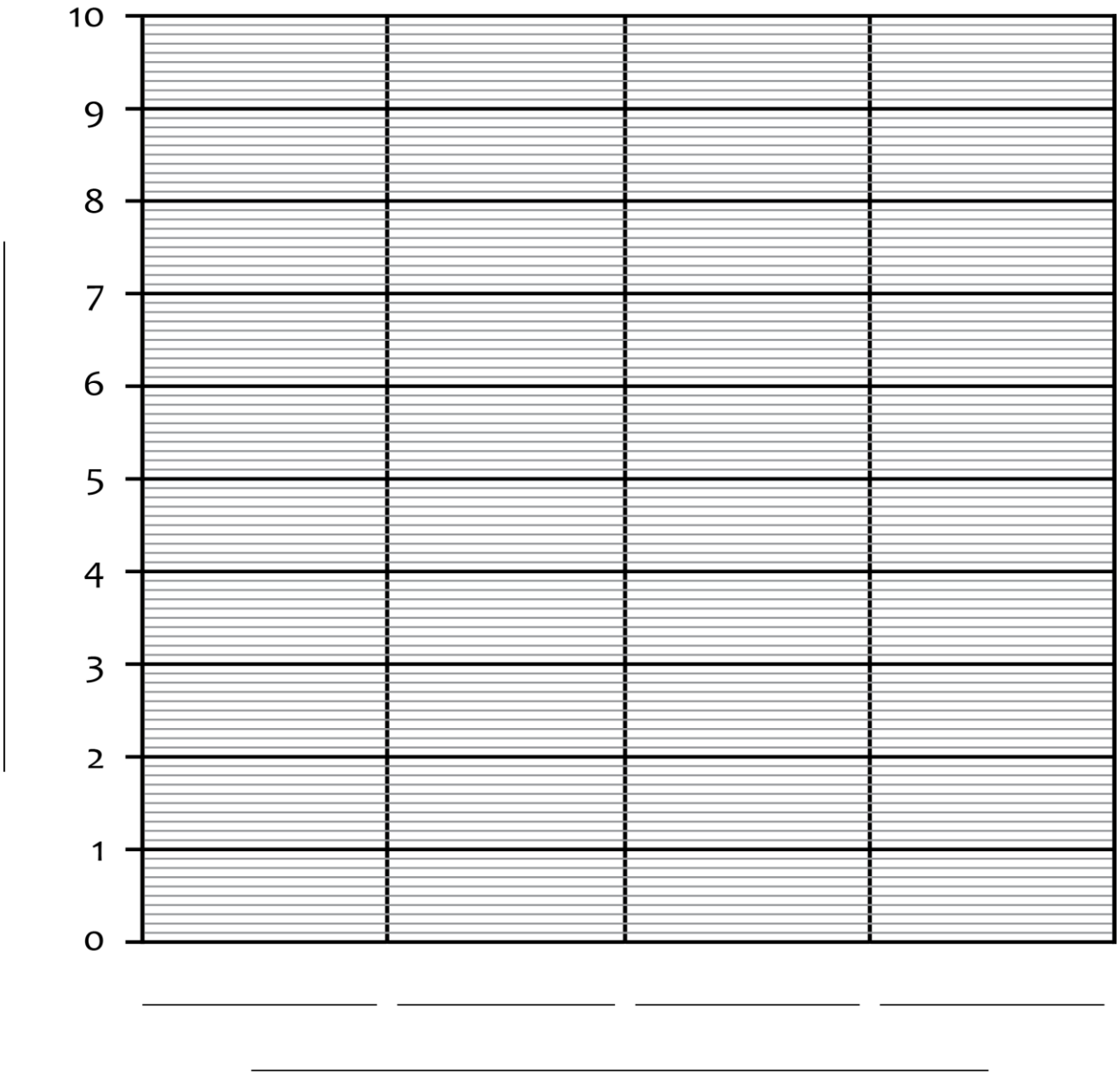
Graph

Set up your graph. (Check off the steps as you complete them.)

- ☐ Label the y-axis (vertical) with what you measured, including units (*Ex*: Current (mA)).
- ☐ Label the x-axis (horizontal) with your changing variable (*Ex:* Blade Angle).
- ☐ On your results table, label your measurements from 1 to 4, with 1 being the trial with the smallest current and 4 being the trial with the largest current.

Plot your data in increasing order.

- ☐ Write the changing variable value (*Ex:* 0°/180°) for the trial that you labeled 1 under the first column.
- ☐ Graph your data for that trial and write the measurement above the bar.
- ☐ Repeat the process for the other trials.



RESULTS

Summary

My experiment shows_____

_____

_____

_____

_____

_____

_____

I acted like a scientist when_____

_____

NOTES ON PRESENTATIONS

What variables affect the current produced by a wind turbine?

Changing Variable:				
Current Produced (mA):				

Changing Variable:				
Current Produced (mA):				

Changing Variable:				
Current Produced (mA):				

Changing Variable:				
Current Produced (mA):				

Changing Variable:				
Current Produced (mA):				

TIE TO STANDARDS

1. What does the current reading tell us?_____

   _____

2. Electric currents are a form of _____.

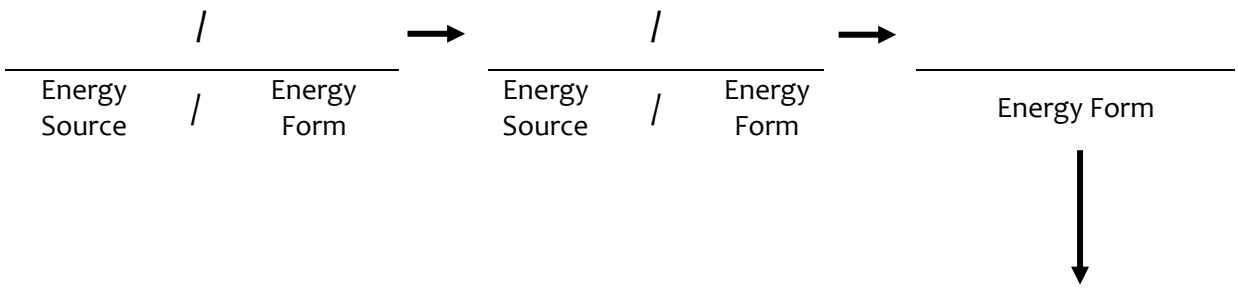
3. _____cannot be created nor destroyed, but it can be _____.

4. Energy can also be _____, such as the case of gravitational energy.

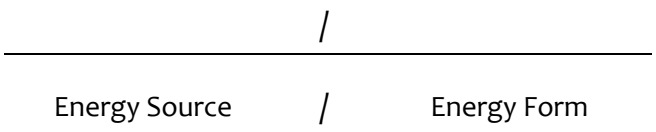
5. Forms of energy

electrical currents	_____
gravitational	_____
_____	_____

6. Identify the energy transfers in the wind turbine.



7. What could the energy in the wind turbine be used for?



8. Magnets can generate _____if the magnet is _____.

9. What are the blades turning inside the wind turbine housing?

_____

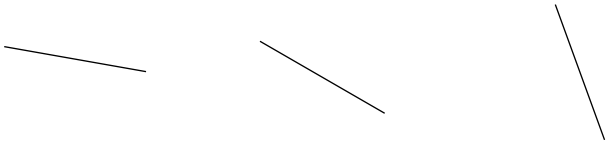
10. What type of area would you recommend that Windy Works purchase land?

_____

11. Windy Works has already decided on the manufacturing specifications below, but needs help deciding which values of three variables to use in constructing their wind turbines.
    1. Circle the value of the changing variable you think Windy Works should use.
    2. Look at the data and box the value of the changing variable that is Windy Works' "best" option.

Wind Turbine Manufacturing Specifications:

Blade Material / Cardstock	Wind Angle / 90°
Blade Number / 3	Weight Placement / 7 cm

	10°	30°	70°
Blade Angle:			
Dowel Placement:	0.5 cm	3.5 cm	6.0 cm
Weight Number:	0	6	12

12. Current produced by ideal wind turbine: _____

EXTRA PRACTICE

Procedures

QUESTION

If we change the solid type, what will happen to the temperature at which the water boils?

EXPERIMENTAL SET-UP

Changing Variable:	Trial A	Trial B	Trial C	Trial D
Solid Type:	Sugar	Salt	Baking Soda	None

Controls (variables you will hold constant)**:**

Solid Amount / 10 g	Heat Source / Bunsen burner
Liquid Amount / 250 mL	Liquid Type / Water
Container Type / Beaker	Container Size / 500 mL

Directions:

Step 1: Read each statement and underline controls, circle changing variables, and box information about data collection.

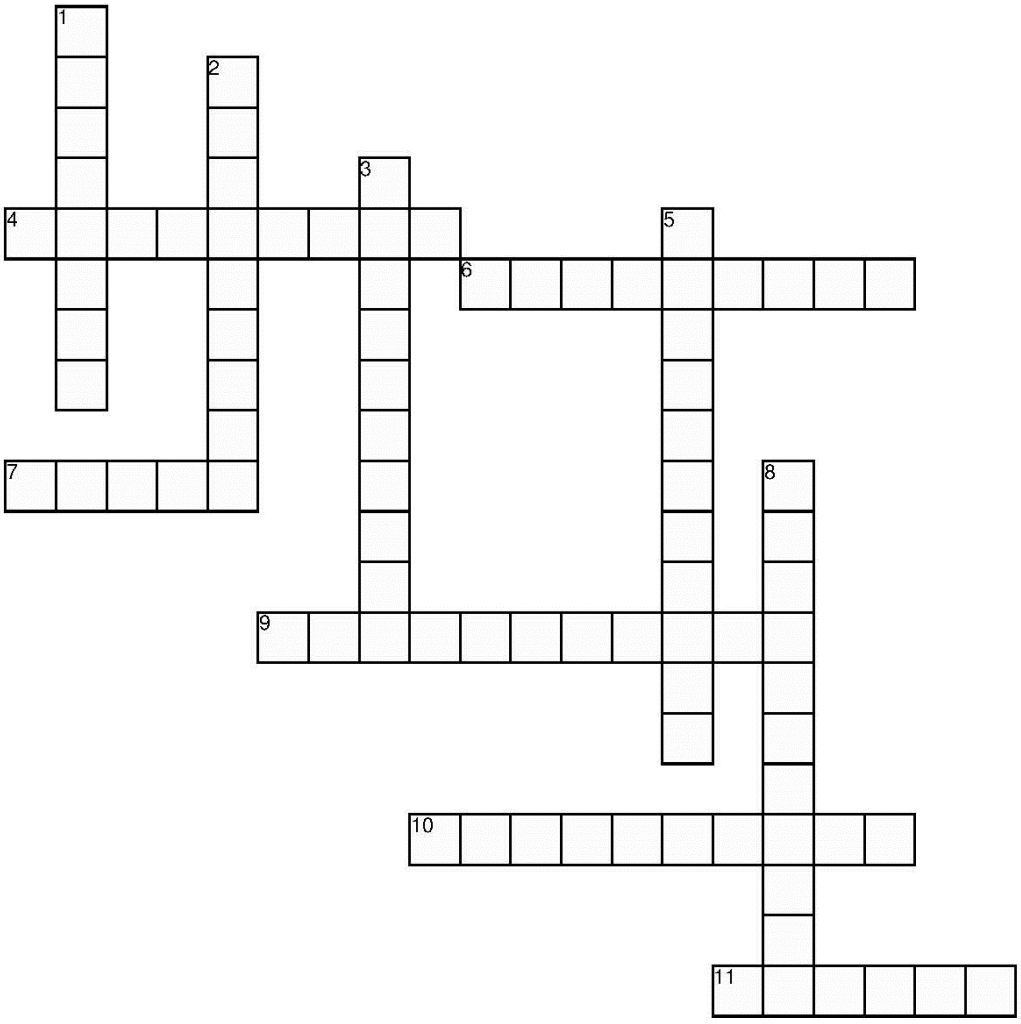
Step 2: Circle yes if the statement could be a correct step for a procedure about the question and experimental set-up above. If not, circle no.

		Could this be a procedure step?	
1.	Put 10 g of A) sugar, B) salt, C) baking soda, D) none into each beaker.	*Yes*	*No*
2.	Light the awesome Bunsen burner.	*Yes*	*No*
3.	Put 250 mL of water into each 500 mL beaker.	*Yes*	*No*
4.	Gather results from the experiment.	*Yes*	*No*
5.	Put 10 g of baking soda into beaker C.	*Yes*	*No*
6.	Measure the temperature the solution boils at.	*Yes*	*No*
7.	Put 10 g of different solid types into each beaker.	*Yes*	*No*

Underline controls, circle changing variables, and box data collection.

CROSSWORD PUZZLE

Directions: Fill out the following crossword puzzle using the clues below. The list of words used for the word search can be found on the vocabulary page of your notebook (pg. 1).



Across

4) a set of steps to conduct an experiment
6) a method for a specific task
7) 90 degrees can describe the _____ of the wind turbine in relation to the fan
9) this fan-like machine can generate electricity when wind causes it to rotate
10) we use this tool to measure the amount of current that the wind turbine produces
11) it can be transferred but it cannot be created or destroyed

Down

1) variables that are not changed in an experiment
2) an interpretation or judgement based on knowledge from past experience
3) what you expect will happen based off of previous measurements or observations
5) designing, building, and modifying a wind turbine is an example of this branch of science
8) describing the color of the wind turbine blades would be an example of an _____

SciTrek is an educational outreach program that is dedicated to allowing 2nd - 12th grade students to experience scientific practices firsthand. SciTrek partners with local teachers to present student-centered inquiry-based modules that not only emphasize the process of science but also specific grade level NGSS performance expectations. Each module allows students to design, carryout, and present their experiments and findings.

For more information, please feel free to visit us on the web at *chem.ucsb.edu/scitrek/* or contact us by e-mail at scitrekelementary@chem.ucsb.edu.

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