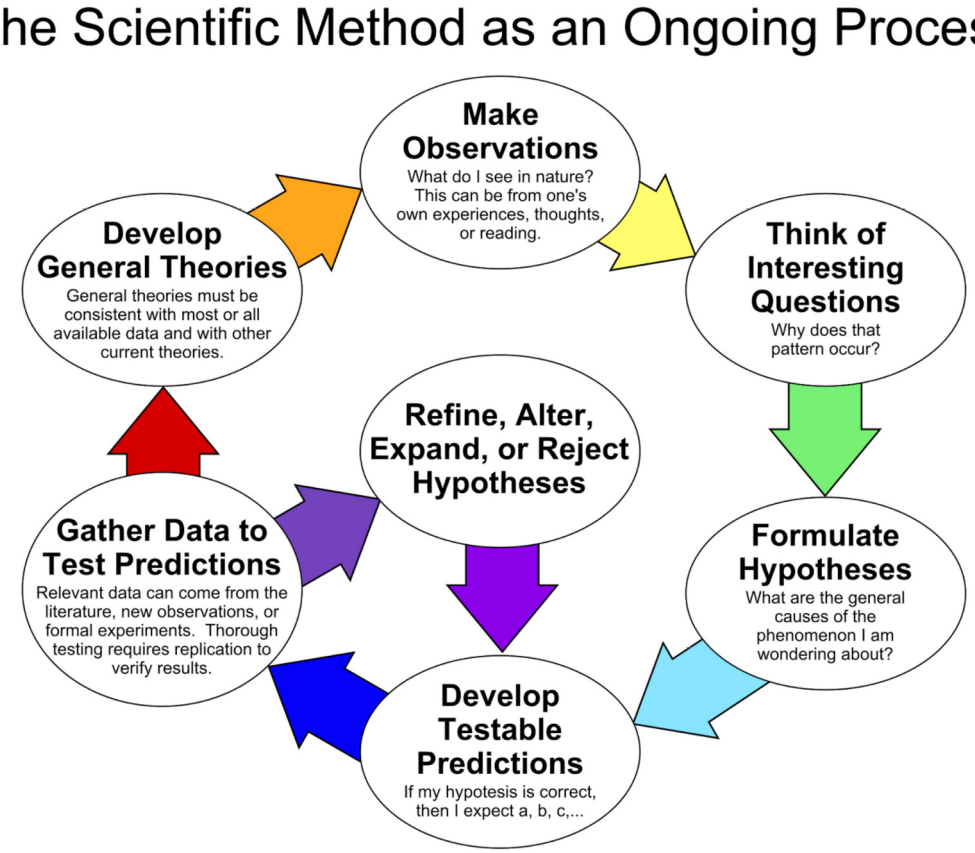
Genesis 1:1 In the beginning, God created the heavens and earth.
Proverbs 4:7 Get wisdom. Though it cost all you have, get understanding.

INVESTIGATION JOURNAL - Gr. 6-8



Investigation Title:
Date:
Lab Partners:

ENGAGE

Where can we get the energy we need?

Demonstration

EXPLORE- Variables we might test are:

ELICIT PRIOR KNOWLEDGE

Memory Box

Record everything you know about wind energy.

How is energy stored, transferred and conserved?

Energy**,** defined as a conserved, substance-like quantity capable of producing a change in a system (the object of interest). Energy can be moved around and stored in a variety of ways, but the energy itself is unchanged. Energy is universal and it does not come in different "kinds" or exist in different "forms." There are many mechanisms for energy storage such as elastic E_e, kinetic E_k, gravitational potential E_g, and chemical potential E_{chem}, where the energy can be easily retrieved. Also, energy can be stored in the random motion of molecules $E_{thermal}$ or the wave motion of molecules E_{sonic}.

As energy is transferred from one method of storage to another, the total amount of energy stays constant (energy is conserved).

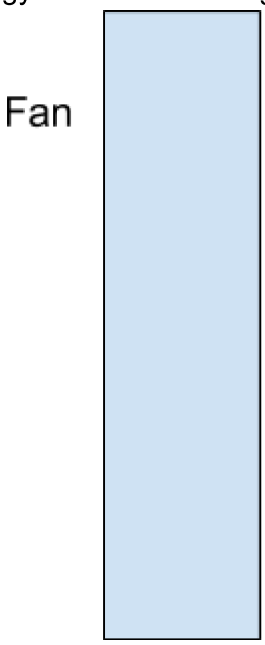
Energy can be transferred from objects or systems through heating, radiating and working. The total amount of energy in the universe is conserved, but it can be stored in different storage modes.

$$\text{Efficiency} = \frac{\text{Useful Energy Output}}{\text{Energy Input}} \times 100\%$$

$$\text{Efficiency} = \frac{\text{Useful Power Output}}{\text{Power Input}} \times 100\%$$

The efficiency of a machine is determined by comparing the amount of energy that comes out of the machine to the amount of energy that went it.

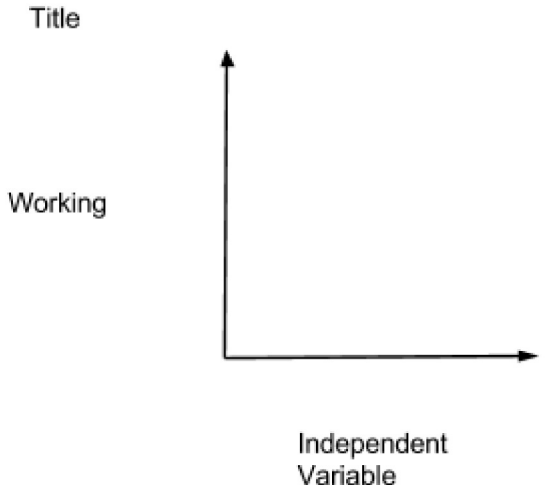
PhET (Physics Education Technology) Simulations
Energy Skate Park - http://phet.colorado.edu/en/simulation/energy-skate-park
Energy Forms and Changes - http://phet.colorado.edu/en/simulation/energy-forms-and-changes



Wealth analogy: We will define "the system" as the personal and institutional places where you keep your money. You can store your money in a number of ways, in a checking account, savings account, cash in a piggy bank, or a stock mutual fund. As you transfer money from cash and savings to checking, the amount of money stays the same (is conserved) even though the money is now stored somewhere else.
(adapted from the ASU Modeling Materials and Mark Schober)

Purpose (Problem): The purpose of this experiment is to determine the relationship between the _____ of the wind turbine blade and the working done by the wind turbine.

Hypothesis:
Qualitative - If _____ increases then the working done by the wind turbine will increase/decrease/stay the same.



EXPLORE
Experimental Design Components:

Independent Variable:
Dependent Variable: Working
Constants (min. 2):

Materials:
Labeled Experiment Design Diagram:
Safety Precautions:
Procedure:

CCSS.ELA-LITERACY.RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.		

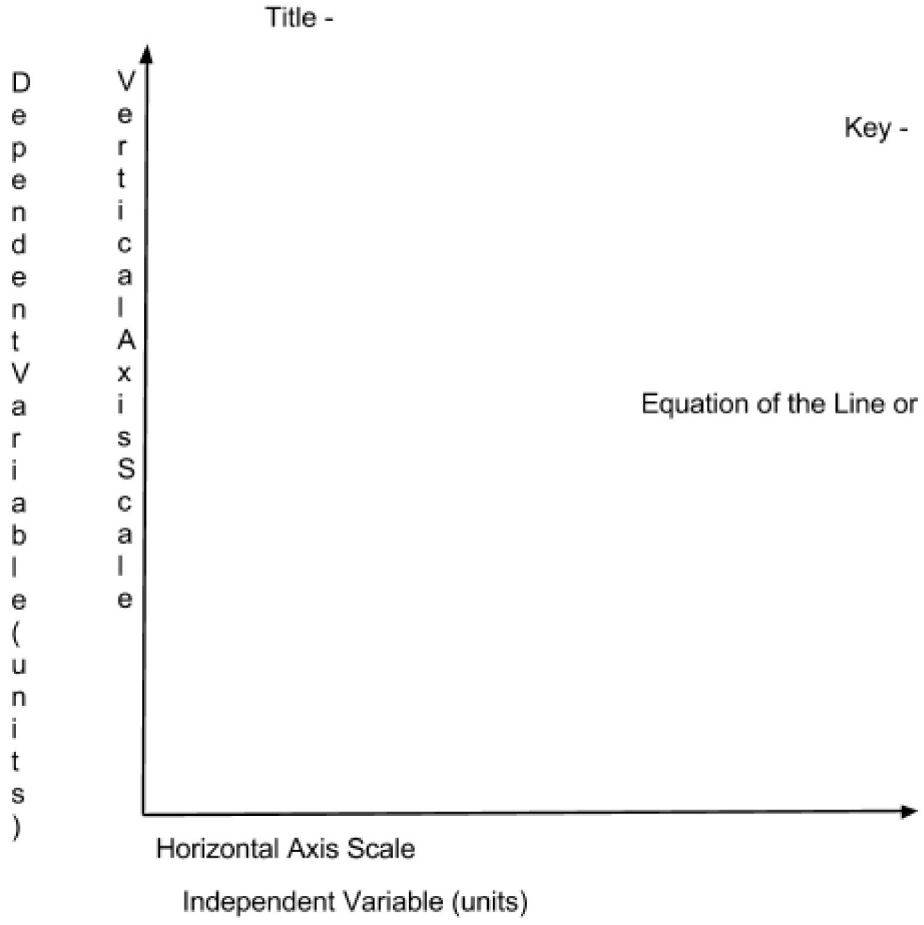
Observations and Data:
Quantitative data (data table):

Title -

Independent Variable (Units) 5 or more different values	***Dependent Variable (Units) 3 or more trials of each value of the independent variable Trial 1 Trial 2 Trial 3***	***Dependent Variable (Units) Average – Place an asterisk * by this column and explain how you calculated the average.***	***Calculated Units Place an asterisk * by this column and explain how you made the calculations.***

Qualitative data (observations):

Space for graph:



EXPLAIN

1. What do you think the data from your experiment means?

2. So what? Why is this important?

3. What are some common misconceptions or errors that are commonly made in regard to this concept?

EVALUATE

4. Revisit your original thoughts and ideas (your answers to the pre-lab questions and discussion points at the beginning of the activity). Record what you think now and record the evidence from the activity that caused you to change any of your thoughts and ideas.
Well, it is my understanding (for now) that (based on research, experience, logic and consideration) . .

. Until new research and evidence come my way I believe . . .

For future experiments . . .

Conclusion: (Choose one or more of the following methods to summarize what you have learned from this investigation and demonstrate that you have accomplished the purpose of the investigation. Select the methods that best match your learning style.)
#1 Write a paragraph that includes three or more sentences.

#2 Make a 3-2-1. (3 new ideas you learned, 2 you already knew, and 1 way in which this affects your life)

(3 of _____, 2 of _____, 1 of _____)

(3 things learned, 2 ways it applies to you, 1 question you have)

(3 things you found out, 2 interesting things, 1 question you have)

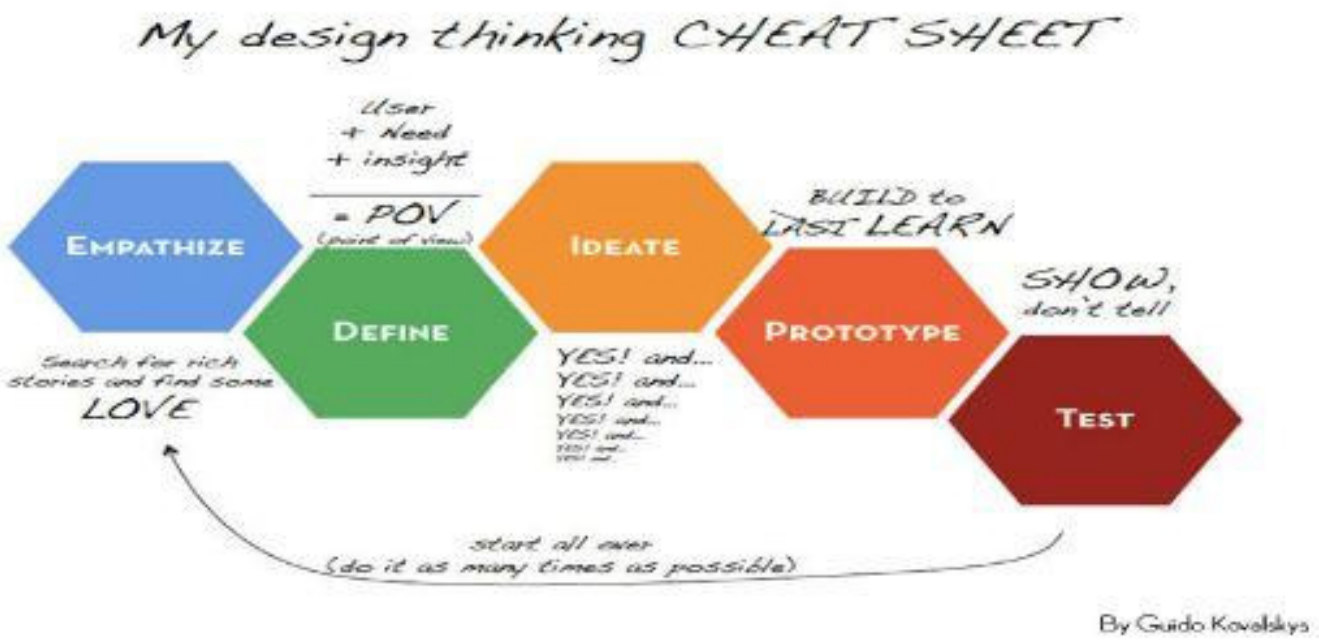
#4 List “Ahas” (surprising or interesting things) and “Affirmations” (things you already knew).

Ahas-

Affirmations -

#5 Create illustrations/drawings/diagrams with labels that help you understand and remember the information

Wind Turbine Design Process and Energy Analysis



NEXT GENERATION SCIENCE STANDARDS (NGSS) - MIDDLE SCHOOL - ENGINEERING
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
Insert Pictures Below of Iterations/Versions of Your Wind Turbine Design:

1. What criteria did your wind turbine need to meet to ensure success?

2. What scientific principles did you utilize when you were designing, building and testing your wind turbine?

3. Of all the designs produced which was the best? Why do you think so?

4. Based on what you have learned from your design and those of your classmates, create a design below for an efficient wind turbine.

5. How is energy stored, transferred and conserved in your wind turbine? (Define energy then name and describe three or more storage modes of energy and two or more methods of energy transfer. Describe more storage modes and transfer methods will help you earn a mastery score. Also describe how energy is conserved as it is stored and transferred.)

Vernier Wind Turbine Options

KidWind MINI Wind Turbine with Blade Design

Recommended for K–8
Demonstrate the power of the wind with an affordable and rugged wind turbine.
Description
The KidWind MINI Wind Turbine with Blade Design allows students to explore basic wind energy production and blade design concepts such as pitch, area, mass, quantity, and material on a desk using a small house fan. This kit is the recommended kit to use with *Investigating Wind Energy*

KidWind MINI Wind Turbine with Blade Design KW-MWTBD $59.00

KidWind Basic Wind Experiment Kit

Recommended for High School and K–8
This popular kit allows young scientists to test a variety of blade designs, generate electricity, and lift weights.
Description
Explore wind energy affordably and easily. This kit, one of our most popular, allows young scientists to test a variety of blade designs, generate electricity (0.5 –3 V range), and lift weights. The Basic Wind Experiment Kit has all the materials you need to get started understanding wind power. Great for classrooms, as well as individual science fair projects.
Classroom Pack - The classroom pack option includes three turbine towers and bases, three nacelles, three generators, eight hubs, and blade consumables for eight groups of 2–4 students.

Activities

- Design and compare turbine blades, Generate electricity, Measure power output, Lift weights
- Light LEDs, Charge capacitors, Compare airfoils and flat blades

Lessons, Tips, and Challenges Go to KidWind.org
Download lessons, learn tips for building turbines, and check out the KidWind Challenges.
KidWind Basic Wind Experiment Kit KW-BWX $109.00
KidWind Basic Wind Experiment Kit (Classroom Pack) KW-BWXC $299
The classroom pack option includes three turbine towers and bases, three nacelles, three generators, eight hubs, and blade consumables for eight groups of 2–4 students