

# LESSON 20: I'VE GOT THE POWER

## Wind Energy Potential at Your School

### PURPOSE/QUESTION

Students will analyze wind energy potential for their school.

### GRADE LEVEL

9-12

### TIME TO COMPLETE

2-3 50-minute class periods

### STANDARDS

See appendix below-page 8

### LEARNING OUTCOMES

- Students will examine wind energy potential throughout the United States.
- Students will learn the relationship between wind speed, altitude (height), and power generation.
- Students will consider what other factors affect wind energy potential.
- Students will learn about how much wind energy their school could generate.

### STUDENT OBJECTIVES

- Access wind data to estimate wind energy potential across the US.
- Determine the average wind speeds at your school (latitude and longitude).
- Calculate and analyze how much wind energy could be generated at your school.
- Learn the relationship between power and energy and the appropriate unit conversions.

### TEACHER BACKGROUND

Renewable energy sources, such as solar and wind, help reduce air pollution and carbon dioxide emissions that cause climate change, by replacing electricity generation from burning fossil fuels. While the current wind turbine technology has allowed wind energy to emerge as a viable energy option, wind energy currently only provides around 1% of the total electricity generation in the United States. Several areas have the potential to generate a significant amount of wind energy, in particular the majority of the Great Plains from Texas to North Dakota and many areas just off-shore the East and West coasts.

Wind is caused by the uneven heating of the Earth's surface by the Sun. On a global scale, the temperature difference from the equator to the poles creates the trade winds that are located at the mid-latitudes. On a more local scale, temperature differences between land and ocean, as well as between mountains and valleys, create wind. The speed and direction of the wind flow are also affected by the Earth's rotation, varying terrain, bodies of water, and vegetation. The distance above the Earth's surface also affects wind speed. Near the Earth's surface there is more friction, which slows the airflow. As you go up in altitude, the wind speeds increase as the surface friction decreases.

Wind turbines convert the kinetic energy of the wind into mechanical power. The wind turns the blades of the wind turbine, which spins the shaft, which connects to a generator and creates electricity. Finding good locations for wind turbines is quite complex because it is important to put them in places where the wind is consistent enough throughout the year to generate enough electricity to offset the cost of installing and maintaining it.

### PREREQUISITES

- [Wind](#)
- [Wind Speed](#)

### MATERIALS & TOOLS

- Computer with Internet
- Microsoft Excel
- Color printer (optional)
- Calculator
- CCC Tech Tips found on pg. 5

### VOCABULARY

- [Altitude](#)
- [Wind Turbine](#)
- [Vegetation](#)
- [Capacity Factor](#)

### LESSON LINKS

- [Live Access Server](#)
- [Opening MY NASA Data microsets in Microsoft Excel](#)
- [POWER Site](#)
- [NWF Offshore Wind Report](#)



**PART 1 – Use POWER to estimate wind energy potential across the U.S.**

**ESSENTIAL QUESTIONS**

1. Based on the map you produced, what are good locations in the United States for generating wind power?
2. What factors might affect wind potential?
3. Why look at wind power at 50 m? How might the values differ at 10 m? at 100 m?

**PROCEDURE**

1. Generate a map of annual average wind speed at 50 m for the U.S.

- a. In the My NASA Data Live Access Server (Advanced Edition), click on the **Choose Dataset** button. Then choose **Surface Meteorology and Solar Energy > Wind Speed Averaged Values at 10 and 50m (July 1983 - June 1993 > Annual Climatology Wind Speed At 50 m Above The Surface Of The Earth (SSE Release 6)**. A map will be automatically generated.
- b. Zoom in on the United States using the small grey map in the upper left-hand corner. Click on the rectangle to activate the tool to select an area. Draw a box over the continental United States (in the small map). Then click **Update Plot** to redraw the map.



**Help with Units:**  
**Power = Energy / Time**

Power is the rate in which energy is generated or used, measured in units of watts (W), kilowatts (kW), or megawatts (MW). Electricity generation and usage is reported in units of power \* time, typically kilowatt hour (kWh) or megawatt Hour (MWh).

According to the U.S. Department of Interior, 1 MW of wind energy could supply electricity to approximately 225 to 300 average U.S. households.

| <b>Wind Power Classification @50 m Height</b><br>National Renewable Energy Laboratory |                    |                  |                  |
|---|--------------------|------------------|------------------|
| Wind Resource Class   | Resource Potential | Wind Speed (m/s) | Wind Speed (mph) |
| 1   | Poor               | 0-5.6            | 0-12.5           |
| 2   | Marginal           | 5.6-6.4          | 12.5-14.3        |
| 3   | Fair               | 6.4-7.0          | 14.3-15.7        |
| 4   | Good               | 7.0-7.5          | 15.7-16.8        |
| 5   | Excellent          | 7.5-8.0          | 16.8-17.9        |
| 6   | Outstanding        | 8.0-8.8          | 17.9-19.7        |
| 7   | Superb             | >8.8             | >19.7            |

## PART 2 – Use POWER to estimate the wind potential at your school

### ESSENTIAL QUESTIONS

1. What is the average annual wind speed at your school? According to the chart above, what is the “Resource Potential” (i.e., the potential for producing wind energy)?
2. How does the wind speed at your school vary throughout the year? Are there certain months that should have better or worse wind energy potential?
3. Does the wind speed at your school have a wide range of values throughout the year or is it fairly consistent? Why might this matter for the potential for producing wind power?
4. How does wind speed at 10 m differ from wind speed at 50 m for ground cover typical of your school's location?

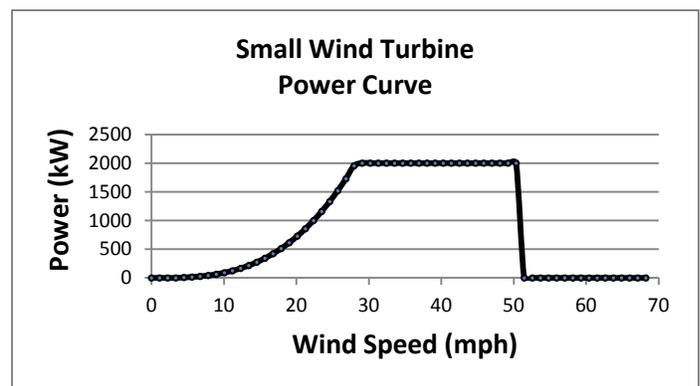
### PROCEDURE

1. We'll use NASA's Prediction of Worldwide Energy Resource Project (POWER) resource to access tabulated data for the latitude and longitude of your school.
  - a. Go to the POWER website at <http://power.larc.nasa.gov/>. We'll be using the Renewable Energy Parameters. Under the Access Data column heading, click on “**SSE-Renewable Energy**”.
  - b. On the next page, click on the link for “**SSE Web Site**”.
  - c. On the next page, under Data Retrieval, click on “**Meteorology and Solar Energy**”.
  - d. Login on the next pages with your email address and a password of your choosing.
  - e. When you get to the page titled “**NASA Surface meteorology and Solar Energy – Location**”, enter the latitude and longitude for the location of your school. Note that West longitude and South latitude will need to be entered as negative values. Then, click **Submit**
  - f. Now a form with lots of variables will come up. Under “**Meteorology (Wind)**”. click on the following three variables while holding down the Ctrl Key:
    - i. Highlight “**Wind Speed at 50 m (Average, Min, Max)**”
    - ii. Highlight “**Percent of time for ranges of Wind Speed at 50 m**”
    - iii. Highlight “**Meteorology (Wind): be sure to select an appropriate VEGETATION type**” highlight “**1) Percent difference for Wind Speed at 10 m from average Wind Speed at 50 m**”, then click **Submit**.
  - g. Tables will be automatically created that display these three variables.
  - h. Insert these values into the POWER Data tab in the Excel spreadsheet. Use this data to answer Essential Questions Part 2.

### Wind Turbine Power Curve

The amount of energy generated by a wind turbine at any time depends on the wind speed, as shown in the example graphic. Below a certain wind speed, the wind turbines do not have enough wind to generate electric power. Once the wind speed reaches the threshold for producing electricity (4.5 mph in this example), the amount of energy generated by the wind turbine increases with the *cube* (to the third power) of wind speed. For example, if the wind speed doubles, the available power increases by a factor of 8 ( $2^3=8$ ).

As wind speed increases, it eventually reaches a threshold for maximum power produced (27mph in this example). This threshold is located on the graph where the power curve flattens out at full power. If wind speed gets too high (greater than 50 mph in this example), the turbine shuts down for safety and mechanical reasons and the generated wind power drops to zero. These exact wind speed thresholds vary among different wind turbines.



## PART 3 – Wind power potential at your school

### ESSENTIAL QUESTIONS

1. What fraction of your school's energy needs could this sample wind turbine reasonably provide?
2. Could wind provide all of the electricity for your school? Why or why not?
3. What are some limitations of your estimate of wind power potential? What additional information would you need to make a better estimate?
4. Use the web to find companies that install wind turbines in your area. Approximately, how much does it cost to install a 20kW wind turbine? Are there any U.S. or state government programs or incentives that might help reduce the cost for your school?
5. Some states allow residences or businesses to sell some power back into the grid. This practice is often called "net metering." Use the web to determine whether this would be an option for your school. If so, during which months might it be most sensible?

### PROCEDURE

1. Assume you are installing a 20 kW (Kilowatt) wind turbine at 10 m height at your school. The wind turbine begins generating power when wind speeds exceed 4.5 mph and can generate the maximum 20 kW when wind speeds are 27 mph or higher. The wind turbine shuts down when wind speeds exceed 50 mph (refer to graphic below). The capacity factor of the wind turbine is 35% (capacity factor = actual power produced/theoretical power produced). This means that 35% of the wind energy is actually converted into usable electricity.
  - a. Using the Excel Spreadsheet tab titled "**Calculations**", insert data for your own school in the places indicated by the red font. The values listed below are calculated for you within this spreadsheet:
    - Wind speed in units of m/s
    - Potential wind power this turbine could generate each year in units of kWh.
    - How much of your school's annual electricity demands can be met with this turbine.

#### STUDENT READING RESOURCES

- [Wind Energy for Schools – Department of Energy\(DOE\)](#)
- [DOE's 20% by 2030 Wind Energy Report](#)

#### TOOLS FOR ASSESSMENT

Science Concept Quiz – found on pg. 13  
 Essay – found on pg. 16  
 Foldables@  
 Student Reading and Science Notebook Assessment Tools – found in the **Rubrics** folder

#### WEBSITES FOR FURTHER LEARNING

- [Wind Energy Info for Small Turbines](#)
- [National Geographic: Harness the Power of Wind](#)



Siemens



## Tech Tips for Eco-Schools USA Climate Change Connections Curriculum

### How do I import data into an Excel spreadsheet?

1. Access data from My NASA Data:
  - a. Once you have all the parameters set for your desired data set (and have clicked "Update Plot" to have your preferences processed), click the "Show Values" button. A new window will pop up with a Table of Values.
  - b. The first several lines of the Table will provide information that describes the data set, often called "metadata", such as the name of the variable, what subset of the data is included in the file, and what time range. Make sure to keep this metadata with the rest of the data when you copy it into Excel. This way you'll be able to easily keep track of which data you have!
2. Copy the data from the browser (note that these instructions are for Internet Explorer running on a PC, and may need to be modified for other platforms):
  - a. In this new window, select all. You can do this by clicking anywhere in the window and then typing "Ctrl-A". Or you can right-click in the window, which will pop up a menu, and then choosing "Select All" from the options.
  - b. Next, copy this data. Again there are two options. You can use the keyboard shortcuts, and type "Ctrl-C". Or you can right-click and choose "Copy" from the pop-up menu.
3. Paste the data into Excel:
  - a. Now open your Excel worksheet and go to the tab where you want to put the raw data. Click in the A1 cell.
  - b. Paste the data, either by typing "Ctrl-V", by clicking "Paste" (located at the left under the "Home" tab), or by right-clicking in the A1 cell and choosing "Paste".
4. Convert the data from text to columns:
  - a. Now, we have the data in Excel, but we can't manipulate it very well because all the data for each row is lumped into one cell. We want to split out each data value into its own cell.
  - b. Starting at the row where the column headers are located (probably around row 7), highlight the A column down to the end of the data.
  - c. Click on the Data tab at the top of the window, and then choose the "Text to Columns" wizard (located a little to the right of center).
  - d. A dialogue box will pop up to help you through the process.
  - e. The first page of the wizard asks you to identify whether the data is "Delimited" or "Fixed width". In most cases, the My NASA Data data will be "Fixed Width", so select that option and click "Next".
  - f. The next page of the wizard gives you a chance to check whether the column breaks make sense and to adjust them as necessary. Make any changes that are needed. Or, go back and switch to "Delimited" on page 1 if you notice that the columns are not lining up as you expected. Once you are satisfied with the columns, click "Next".
  - g. The final page of the wizard allows you to designate what kind of data values are in each column and a destination for the data. For the purposes of the CCC curriculum, we'll just accept the defaults and click "Finish".
  - h. Now your data should be in beautiful columns and the values should make sense. It's always a good idea to double check that nothing crazy happened!



**My NASA Data isn't working! What should I do?**

1. Double check that you entered everything correctly. Especially check that you have the right data set and that you have entered dates and latitude/longitude values within the range of available data. Usually the user interface will prevent you from entering invalid data ranges, but sometimes there are glitches.
2. Refresh the browser and/or restart the browser. Occasionally, a fresh start is the easiest way to clear out any mistakes or glitches.
3. Update your browser and/or JAVA. If you have older versions of the software, then you might find that some functionality is lost.
4. If you're still struggling, consider whether problem might be at the My NASA Data website. It might be a temporary problem, in which case taking a break and returning to the site at a later time could be a good choice. Or it could be a more significant problem, in which case you'll want to explore the "help" resources provided by My NASA Data (link in upper right hand corner of page).
5. Ask your Eco-Schools contact for help or email [eco-schoolsusa@nwf.org](mailto:eco-schoolsusa@nwf.org)!

**How do I print or save a map or graph?**

1. Use the "Print" button to generate a version of your map or graph that is suitable for saving or printing. Once you click on the "Print" button, a new window will pop up with your map or graph.
2. Print a map or graph by using the print option on your browser.
3. Save a map or graph in one of two ways:
  - a. By choosing "Save as" in the browser. Use the defaults to save as a "Web Archive, single file (\*.mht)".
  - b. By right clicking and choosing "Save picture as..." Use the defaults to save as a \*.png file.
4. When saving, make sure to give your new file a descriptive name and put it somewhere that you'll remember!

**How do I find my latitude and longitude?**

A number of sites help you find your latitude and longitude. For example:

1. <http://itouchmap.com/latlong.html>
2. <http://www.findlatitudeandlongitude.com/>



## LESSON 20-APPENDIX

### WEB ADDRESSES FOR HYPERLINKS

#### Prerequisites

- **Wind**  
<http://amsglossary.allenpress.com/glossary/search?id=wind1>
- **Wind Speed**  
[http://www.ehow.com/about\\_5035434\\_wind-speed.html](http://www.ehow.com/about_5035434_wind-speed.html)

#### Vocabulary

- **Altitude**  
<http://mynasadata.larc.nasa.gov/science-glossary/>
- **Wind turbine**  
[http://www.nrel.gov/learning/re\\_wind.html](http://www.nrel.gov/learning/re_wind.html)
- **Vegetation**  
<http://dictionary.reference.com/browse/vegetation>
- **Capacity factor**  
<http://teeic.anl.gov/er/wind/restech/scale/index.cfm>

#### Lesson Links

- **Live Access Server, LAS – NASA data portal for students**  
<http://mynasadata.larc.nasa.gov/live-access-server/>
- **Opening NASA Microsets in Excel**  
<http://mynasadata.larc.nasa.gov/opening-my-nasa-data-microsets-in-excel/>
- **POWER – Prediction of Worldwide Energy Resource – houses solar and wind data from NASA's Applied Science Program within the Earth Science Mission Directorate**  
<http://power.larc.nasa.gov/>
- **NWF Offshore Wind Report – This report is found at the bottom of the page under “Related Resources”**  
<http://www.nwf.org/Global-Warming/Policy-Solutions/Renewable-Energy/Offshore-Wind/Offshore-Wind-Wildlife-Impacts.aspx>

#### Student Reading Resources

- **Wind Energy for Schools – Department of Energy (DOE)**  
<http://www.windpoweringamerica.gov/schools.asp>
- **DOE: 20% by 2030 Wind Energy Report**  
<http://www.nrel.gov/docs/fy08osti/41869.pdf>

#### Websites for Further Learning

- **Wind Energy Information for Small Turbines**  
[http://www.windpoweringamerica.gov/small\\_wind.asp](http://www.windpoweringamerica.gov/small_wind.asp)
- **National Geographic: Harness the Power of Wind**  
<http://environment.nationalgeographic.com/environment/global-warming/wind-power-interactive.html>



**LESSON 20-STANDARDS****National Science Education Standards****Unifying Concepts and Processes**

- Unifying Concepts and Processes
- Systems, order, and organizations
- Evidence, models, and explanation

**Standard A – Science as Inquiry**

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

**Standard B – Physical Science**

- Motions and forces

**Standard D – Earth and Space Science**

- Energy in the earth system

**Standard E – Science and Technology**

- Understandings about science and technology

**Standard F – Science in Personal and Social Perspectives**

- Natural resources
- Science and technology in local, national, and global challenges

**Standard G – History and Nature of Science**

- Science as a human endeavor

**National Education Technology Standards****Standard 1: Creativity and Innovation**

- Use models and simulations to explore complex systems and issues
- Identify trends and forecast possibilities

**Standard 3: Research and Information Fluency**

- Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
- Process data and report results

**Standard 4: Critical Thinking, Problem Solving, and Decision Making**

- Collect and analyze data to identify solutions and/or make informed decisions.



**Standard 6: Technology Operations and Concepts**

- Understand and use technology concepts
- Select and use applications effectively and productively
- Troubleshoot systems and applications
- Transfer current knowledge to learning of new technologies

**National Council of Teachers of Mathematics Standards****Algebra**

- Understand patterns, relations, and functions
- Use mathematical models to represent and understand quantitative relationships
- Analyze change in various contexts

**Measurement**

- Understand measurable attributes

**Process**

- Connections
  - Recognize and apply mathematics in contexts outside of mathematics
- Representation
  - Use representations to model and interpret physical, social, and mathematical phenomena

**Climate Literacy Principles**

**Principle 1:** The sun is the primary source of energy for earth's climate system.

**Principle 2:** Climate is regulated by complex interactions among components of the Earth system.

**Principle 4:** Climate varies over space and time through both natural and man-made processes.

**Principle 5:** Our understanding of the climate system is improved through observations, theoretical studies, and modeling

**Energy Literacy Principles**

**Principle 1:** Energy is a measurable quantity that follows physical laws.

**Principle 2:** Physical Earth processes are the result of energy flow through the earth system.

**Principle 4:** Various sources of energy can be used to power human activities, and often this energy must be transferred from source to destination.

**Principle 5:** Individuals and communities make energy decisions every day.

**Principle 7:** The energy choices made by individuals and societies affect quality of life.

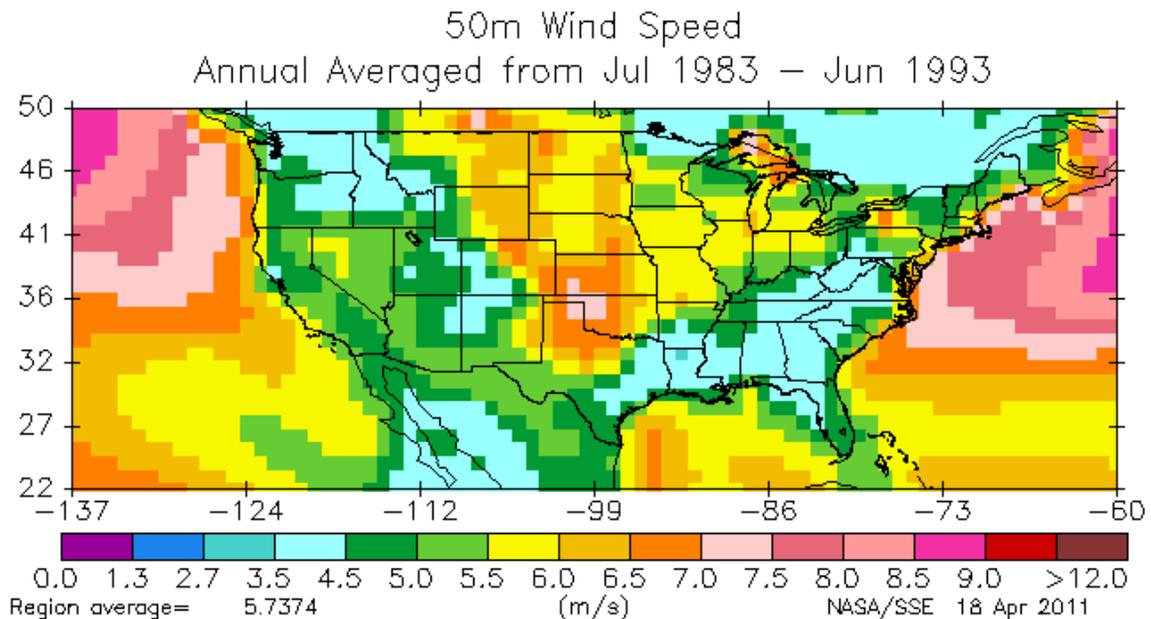


## LESSON 20-ESSENTIAL QUESTIONS ANSWER KEY

## Essential Questions-1

1. Based on the map you produced, what are good locations in the United States for generating wind power?

[The best continental locations are the Great Plains regions of the central United States, ranging from Texas) to the Canadian border. Wind speeds are also high off the east and west coasts of the country. Although it can't be seen on the map because the data is at coarse spatial resolution, wind speeds are high along the ridges of the Rockies and Appalachian mountains.]



2. What factors might affect wind potential?

[Wind is caused by the uneven heating of the Earth's surface by the sun. On a global scale, the temperature difference from the equator to the poles creates the trade winds that are located at the mid-latitudes. On a more local scale, temperature differences between land and ocean, as well as between mountains and valleys, create wind. The speed and direction of the wind flow are also affected by the Earth's rotation, varying terrain, bodies of water, and vegetation. The height (altitude) of the Earth's surface also affects wind speed. Near the Earth's surface there is more friction, which slows the airflow. As you go up in height, the wind speeds increase significantly as the surface friction decreases.]

3. Why look at wind power at 50 m? How might the values differ at 10 m? at 100 m?

[The wind speed varies quite significantly with height. Near the Earth's surface there is more friction, which slows the wind. As you go up in height, the wind speeds increase as the surface friction decreases. Thus, wind turbines are often built high enough to take advantage of the higher wind speeds. Wind speed at 10 m altitude would be less than that at 50 m. Wind speed at 100 m altitude would be greater than that at 100 m.]

**Essential Questions-2**

(Answers will vary depending on your school's location. Sample answers are provided using the example location of Amarillo, TX.)

1. What is the average annual wind speed at your school? According to the chart below, what is the "Resource Potential" (i.e., the potential for producing wind energy)?  
[The average annual wind speed in Amarillo, TX is 6.5 m/s (found in POWER data tab in Excel in box titled "Monthly Averaged Wind Speed at 50 m Above The Surface Of The Earth"). According to the chart, it has a Resource Potential of "Fair."]
2. How does the wind speed at your school vary throughout the year? Are there certain months that should have better or worse wind energy potential?  
[The wind speed in Amarillo, TX varies only a little bit throughout the year. There is a slight increase in wind potential during the springtime.]
3. Does the wind speed at your school have a wide range of values throughout the year or is it fairly consistent? Why might this matter for the potential for producing wind power?  
[The wind speed does not vary that much from month to month which means this location is potentially good for wind turbines. Consistent wind speed is important because it means a more dependable source of wind power.]
4. How does wind speed at 10 m differ from wind speed at 50 m for ground cover typical of your school's location?  
[Assuming that the typical groundcover in this Amarillo location is "0.5-m broadleaf shrubs (variable %) & groundcover," the wind speed at 10 m altitude is about 35% less than that at 50 m altitude.]

**Essential Questions-3**

(Answers will vary depending on your school's location. Sample answers are provided using the example location of Amarillo, TX.)

1. What fraction of your school's energy needs could this sample wind turbine reasonably provide?  
[This sample turbine could fulfill around 5% - 6% of the school's energy needs.]
2. Could wind provide all of the electricity for your school? Why or why not?  
[Wind could potentially provide all of the electricity if there were enough wind turbines – in this case about 20 wind turbines would be needed. However, a constraint would be how much land is available on which to place these wind turbines. Also, another energy source would likely be required to provide electricity on days with little wind.]
3. What are some limitations of your estimate of wind power potential? What additional information would you need to make a better estimate?  
[The calculation uses monthly and regional average values for wind speed, but wind can vary significantly over time and space. Likewise, the calculation uses a single average ground cover type to determine the impact of surface friction. A more precise estimate of wind power potential could be made by measuring wind speed at your specific location throughout the year. Another improvement would be to use the characteristics (e.g., the capacity factor, minimum and maximum wind speed values) for the specific wind turbine being considered for the location.]



4. Use the web to find companies that install wind turbines in your area. Approximately, how much does it cost to install a 20kW wind turbine? Are there any U.S. or state government programs or incentives that might help reduce the cost for your school?

[Answers will vary regarding the cost and available incentives. For example, Wind Inc. (<http://www.wind-inc.com>) offers 20 kW turbines for \$67,900 + installation. Their site also lists a variety of incentives that can help finance energy audits and wind power installation.]

[The U.S. Department of Energy also has programs targeted at installing wind power at schools. More information is available at:

<http://www.windpoweringamerica.gov/schools.asp>]

5. Some states allow residences or businesses to sell some power back into the grid. This practice is often called "net metering." Use the web to determine whether this would be an option for your school. If so, during which months might it be most sensible?

[The Pew Center on Global Climate Change maintains a useful site on what different states are doing to address climate change. Here's a link to the page focused on net metering:

[http://www.pewclimate.org/what\\_s\\_being\\_done/in\\_the\\_states/net\\_metering\\_map.cfm](http://www.pewclimate.org/what_s_being_done/in_the_states/net_metering_map.cfm)]

[The State Environmental Resource Center is another place to identify programs that different states are implementing. <http://www.serconline.org/netmetering/stateactivity.html>]



Name: \_\_\_\_\_ Date: \_\_\_\_\_

**Science Concept Quiz****Lesson 20: I've Got the POWER! Wind Energy Potential at your School**

**After looking at wind potential where you are located what would be the best first recommendation if you were advising a peer from another school?**

- A. Research wind turbine companies like BTI Wind or Wind Energy for Schools from the Department of Energy to get the cost of a project.
- B. Give them your wind data.
- C. Research the pros and cons of wind power.
- D. Use the POWER tool to identify if you have enough wind in your location, over the course of a year to make having a wind turbine feasible.

\_\_\_\_\_ points out of 20

**I. Answer**A.  B.  C.  D. 

\_\_\_\_\_ points out of 15

**II. What is the main concept behind the question?**

- 1. Communicating procedures effectively
- 2. Wind energy
- 3. Renewable resources
- 4. Data collection

\_\_\_\_\_ points out of 25

**III. Provide the reasoning for choosing your answer in part II.**

\_\_\_\_\_ points out of 40

**IV. Why are the other responses in part I not the best answer choice?**

- 1.
- 2.
- 3.
- 4.

Use the rest of this page if more room is needed to fully communicate your thoughts.



**Teacher Answer Key**

1. D
2. 1
3. Answers will vary. When scientist work together on a common theme it is important to be able to communicate effectively to build a working partnership with the other group. Leading one in the wrong direction, even if unintentional, could be bad for your career.
4. Answers will vary
  - A) Research wind turbine companies is an important step in the research process when considering wind energy, but many other questions have to be answered first.
  - B) Sharing information with colleagues is a great skill and will help build partnerships, but since your locations are different you will not be able to use the same data for this project.
  - C) Researching the pros and cons of wind energy is an important to know, but it is not the first step in the process.
  - D) This is the correct answer. Using the POWER tool will allow you to first find out if further research is needed. The POWER tool will tell me if there is enough wind energy potential to continue on with my research efforts which will include, pros and cons and cost.



Student Name  
Teacher/Class  
Date

**Lesson 20: I've Got the POWER! Wind Energy Potential at my School**

Renewable energy is critical to sustaining our energy needs. There are many arguments for and against renewable energy. Take a position, **for or against** and write a position statement regarding the use of wind energy in your community. Be sure to include 3 fact based pieces of evidence to support your position.

***What Is the Expectation?***

*Use new lesson knowledge or student readings to support your position*

*Visual representations if applicable*

*Key vocabulary*

*Evidence of on grade level spelling and grammar usage*

