

Duration: 55 minutes

MATERIALS

Graph paper
Internet access, LCD projector or
SMART Board

RESOURCES

Web Video: [The Answer is Blowing in the Wind](#), Canadian Wind Energy Association Website

[Blueprint For Life/Work Designs – The Quick Reference Guide](#)

INSTRUCTIONAL METHODS

Group Discussion
Direct Instruction
Research
Individual / Cooperative Learning



LESSON OBJECTIVES

- ✓ Students will understand that professional careers allow individuals to engage in work experiences that satisfy one's needs as well as contribute to society (BP 6.3.10)
- ✓ Students will understand that Electrical Engineers find new and better ways to generate power, with less impact on our environment
- ✓ Students will demonstrate the ability to read information from a graph (B.5)
- ✓ Students will demonstrate the ability to identify, graph, and interpret examples of linear functions describing real-world situations (B.6)
- ✓ Students will demonstrate the ability to identify, describe, and interpret examples of direct variation in real-world situations (B.19)

BACKGROUND INFORMATION

Electrical Engineers make the generation and use of electrical energy safe, efficient, and reliable. They're also involved in communications, computer engineering, digital signal processing, electronic materials and devices, and instrumentation.

Demand for electricity is increasing. Many of our power plants are approaching retirement and will soon need to be replaced. We need more power, and concerns over air pollution and climate change mean that we need to look for cleaner ways to generate it. One way to do that is to generate power from wind, which does not produce greenhouse gas emissions (emissions thought to be linked to climate change). Wind turbines capture the kinetic energy available from wind, and convert it into electrical energy.

Currently, wind generation makes up about 5% of the generating capacity in Saskatchewan (the highest percentage in all of Canada). We could potentially use wind generation to make up between 10% and 20% of our total generating capacity. If that is achieved, this would mean a considerable reduction in greenhouse gas emissions for Saskatchewan, and would help provide a cleaner planet for future generations.

MOTIVATIONAL SET

Watch the video: [The Answer is Blowing in the Wind](http://www.canwea.ca/wind-energy/index2_e.php), produced for the Canadian Wind Energy Association (http://www.canwea.ca/wind-energy/index2_e.php - approximately 11 minutes long). Ask the students the following questions for discussion:

1. What are the benefits of wind energy?
2. What is the goal of the Canadian Wind Energy Association?
3. What progress is being made in Canada toward that goal?

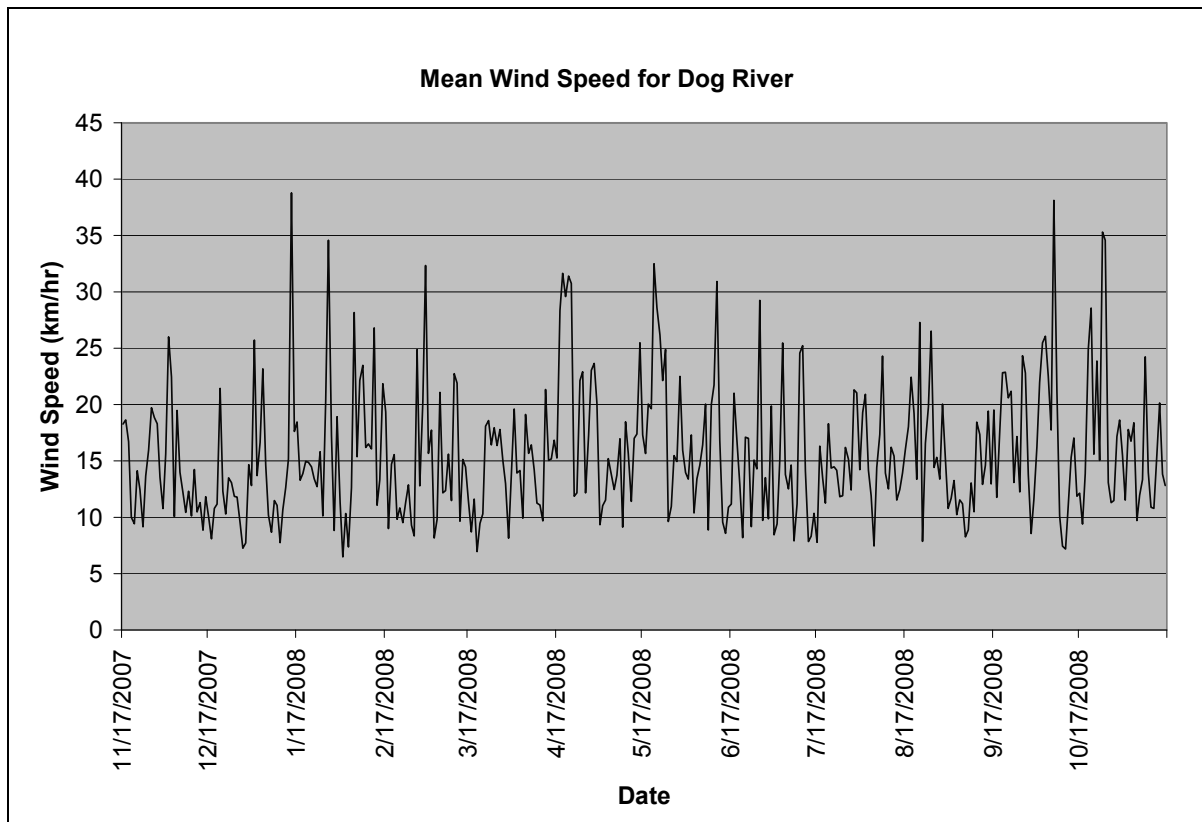
Tell the students that today they are going to be electrical engineers, helping to design a new wind farm for Saskatchewan.

PROCEDURE / TIMELINE

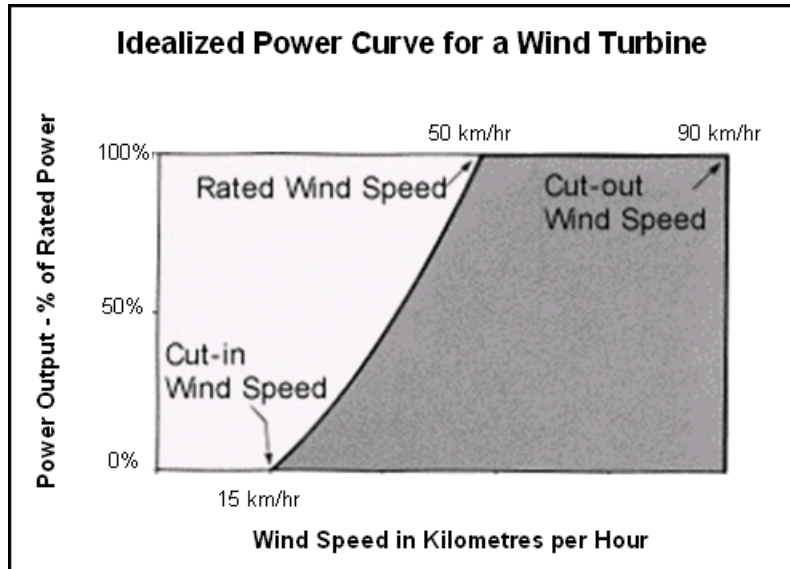
I. Site Selection for Wind Farm

Give students the following graphs that they will use to determine if a given site is a suitable location for a new wind farm.

A graph of daily wind data over the previous year for the site 'Dog River, SK' was obtained from Environment Canada. This graph plots the daily mean wind speed (km/hr) for the previous year.



A graph showing the idealized power curve for a specific model of wind turbine was obtained from the manufacturer. This graph shows the cubic relationship between wind speed, and power output, over the operating range of the turbine. This means that for every doubling of wind speed, the power output of the turbine increases eight fold! (i.e. $2^3 = 8$)



Have students answer the following questions:

1. What is the range of wind speeds that generate power?
2. What range of wind speeds generates the maximum amount of power?
3. What range of wind speeds will result in no power being generated?
4. As an Electrical Engineer, would you recommend Dog River as a suitable location for a new wind farm? Why, or why not?

II. Determining Size of the Wind Farm

Saskatchewan's major wind power facilities all calculate their annual generation based on formulas developed for their particular location, specifications and expected maintenance schedules. Saskatchewan's rich wind resources allow for an expected annual generating capacity of around 40 percent. This means that on average, a wind turbine operating in Saskatchewan will produce 40% of its rated output power. Based on this, the average wind turbine can produce enough electricity to serve approximately 600 homes.

Have the students write an equation that relates the number of turbines to the number of homes that are provided with electricity. Students should also create a table of values and graph the relationship.

Have students answer the following questions:

1. Is this a linear relationship?
2. Is this a direct variation? If yes, what is the constant?
3. How many homes could be served if there are 16 wind turbines in the wind farm?
4. How many wind turbines would need to be built if the wind farm is to serve 69,000 homes (the size of a major city in Saskatchewan)?

DEBRIEF

1. As an electrical engineer, what is the single most important factor to consider when selecting a location for a wind turbine? Why?
2. Why is it important that engineers develop new and better ways to generate clean power?
3. Can you name other professional careers that contribute positively to society?
4. Why might someone choose a career in engineering or geoscience?
5. What subjects might an electrical engineer need to be good at in order to be successful?

ASSESSMENT / INDICATORS

The indicators that the teacher will be looking for are an understanding by the students of the following items:

1. The students understand that professional careers allow individuals to engage in work experiences that satisfy one's needs as well as contribute to society.
2. The students are able to demonstrate the ability to read information from a graph.
3. The students are able to identify, graph, and interpret examples of linear functions
4. The students are able to identify, describe, and interpret examples of direct variation.