

People for Energy and Environmental Literacy (PEEL)

Lesson Plan 6

Wind Energy

Basic Level

Intermediate Level

Advanced Level

Date: January 2019

Version 1.1

Summary of Activity

Grade: 3 – 12

Subject: Science, Social Studies

Time: 1.5 – 2 Hr

Theme: Wind Energy

Description:

Learn about wind energy generation from how a turbine is built to how it converts the kinetic energy from wind to mechanical energy that we can use to power our homes. Also, learn about how the wind resource is assessed prior to installation. Three presentations are available:

Basic level – Grades 3-5

Intermediate level – Grades 6-8

Advanced level – Grades 9-12

What's included:

PowerPoint file – Wind Energy – Basic Level (Grades 3-5)

PowerPoint file – Wind Energy – Intermediate Level (Grades 6-8)

PowerPoint file – Wind Energy – Advanced Level (Grades 9-12)

Each PowerPoint file has notes on each slide with questions and advice for the instructor.

This lesson can be completed over two class periods. There is a quiz at the end of the presentation that students can complete to test their understanding of the material. There is also an activity on building a wind turbine.

Overview

In this lesson, students will gain an understanding of wind energy and how it works. The lesson begins with a broad overview of what wind is and then goes into detail on the components of a turbine, how to build a turbine, and the devices used for wind measurements. This lesson is an extension of Lesson 4 – Renewable Energy 101. It is recommended that students complete Lesson 4 prior to beginning Lesson 6 – Wind Energy. By the end of the lesson, students can complete the 'Wind Turbine Design Challenge.' This activity allows students to think outside the box and get creative with their designs. They must research ways to build a turbine and test if their design is sufficient to meet the criteria specified.

Curriculum Links

The table below provides a guide to some of the curriculum links between this lesson plan and grades and subjects.

Table 1: Curriculum links to this lesson plan

Grade Level	SUBJECT			
	Science	Social Studies	Career & Technology Studies	Environment and Outdoor Education
3	Testing Materials and Designs	Global Citizenship	<ul style="list-style-type: none"> Environmental Stewardship Occupational Area, Primary Resources Occupational area, Agriculture Occupational Area 	<ul style="list-style-type: none"> Part of a complex global environment Human life and life styles are dependent on environmental resources Humans influence environment through direct and indirect means Principles of conservation
4	Waste and Our World	Alberta: A Sense of Land		
4		Alberta: Celebrations and Challenges		
5	Electricity & Magnetism			
6		Citizens Participating in Decision Making		
8	Mechanical Systems			
9	Electrical Principles and Technology	Issues for Canadians: Economic System in Canada and the United States		
10	Energy and Matter in Chemical Change			
10	Energy Flow in Technological Systems			
10	Energy Flow in Global Systems			
10	Stewardship			
11	Science Technology and Society			
12	Chemistry and the Environment			
12	Energy and the Environment			

In addition to curriculum links, there are also direct links to the Alberta 21st Century Learner competencies.

CRITICAL THINKING	COMMUNICATION
PROBLEM SOLVING	COLLABORATION
MANAGING INFORMATION	CULTURAL AND GLOBAL CITIZENSHIP
CREATIVITY AND INNOVATION	PERSONAL GROWTH AND WELL-BEING

Figure 1: Alberta 21st Century Learner Competencies

This lesson focuses on the following learner competencies:

- Critical Thinking
- Problem Solving
- Creativity and Innovation
- Collaboration

Energy and Environmental Learning Outcomes

By the end of the lesson, students should be able to:

- Understand how wind energy works
- Understand where Alberta's wind resource is located
- Identify the main components of a wind turbine
- Identify the different types of wind energy
- Identify the different types of turbines and the advantages/disadvantages of each

Planning Notes

Materials

- Wind Energy PowerPoint presentation (different versions available online for basic, intermediate and advanced)

Prior Learning

This lesson builds on the learnings from Lesson 4 – Renewable Energy 101. It is recommended that students are aware of what wind energy is, and the energy conversion that occurs in this process.

Teaching/Learning Strategies

This lesson can be taught with the slide presentation, or with alternative research and analysis completed on their own. The slide presentation provides in-class activities that can be done during the presentation. There is also a short quiz to test the student's knowledge.



Instructions

Pre-activity discussion

Ask the students what they think they would need to consider if they were to build a wind turbine. What materials do they think would be best to use? The goal of this is to get the students thinking of how they would build a turbine of their own out of materials they can find around the classroom.

Activity

Students will be presented with the Wind Energy presentation. The teacher will discuss the presentation with the students on all things related to wind energy. Following the slide presentation, students are tasked with designing a wind turbine (Wind Turbine Design Challenge). Students must build their own wind turbine that can lift a weight without breaking. See the attachment below for the full instructions.

Post-Activity questions (Follow up questions to Wind Turbine Design Challenge)

1. What materials worked best? What did not work?
2. What changes would you make to your design? What would you keep?
3. Did your turbine successfully lift the weight?
4. Were there any struggles during the challenge. If so, what were they?
5. What did you learn from this activity?
6. What design worked best?

Extension

With your current wind turbine, test if it can lift a heavier weight, and determine the weak points. Redesign your turbine if it did not pass the challenge.

Resources

All resources are identified in the PowerPoint presentation in the notes section.

Print resources

See the attached activity to be distributed around the class.

Websites

- This page on the Canadian Wind Energy (CanWEA) website is a great resource for more information on wind in Canada. Take a look if you want to learn more facts about wind:
 - <https://canwea.ca/wind-facts/why-wind-works/>

Videos

- This video by Student Energy discusses how wind power works
 - <https://www.youtube.com/watch?v=Z5c50-hcD0>



- This video shows how a wind turbine is erected, from start to finish. You can see that this is a large project and takes a long time to complete
 - https://www.youtube.com/watch?v=84BeVq2Jm88&feature=player_embedded

GreenLearning.ca

The following resources are GreenLearning activities that are related to this PEEL topic.

- Re-Energy: <http://www.greenlearning.ca/programs/re-energy/>

Data References

References are available in the Wind Energy presentation in the notes section of the PowerPoint Document.

Feedback

We are continuously interested in improving and updating this lesson plan. Please send your feedback to info@teachpeel.ca.

ACTIVITY – WIND TURBINE DESIGN CHALLENGE

Background

A **wind turbine** is a rotating machine that converts the **kinetic energy** of the wind into **mechanical energy**. This energy can be used by machinery directly attached to the spinning blades (windmill), or it can be converted into other types of energy through a generator (wind turbine). For your design, you will be creating more of a windmill because we aren't going to be generating electricity. To create electricity, the spinning **blades** are attached in the middle by a **rotor** which is connected to a low-speed **shaft**. This shaft is attached to a **gearbox** which increases the speed to spin another shaft inside a **generator**. This generator then uses magnets to create electricity. This electricity may be combined with other wind turbines in the same **wind farm** to be used locally, or it can be sent to a power grid to be used farther away.

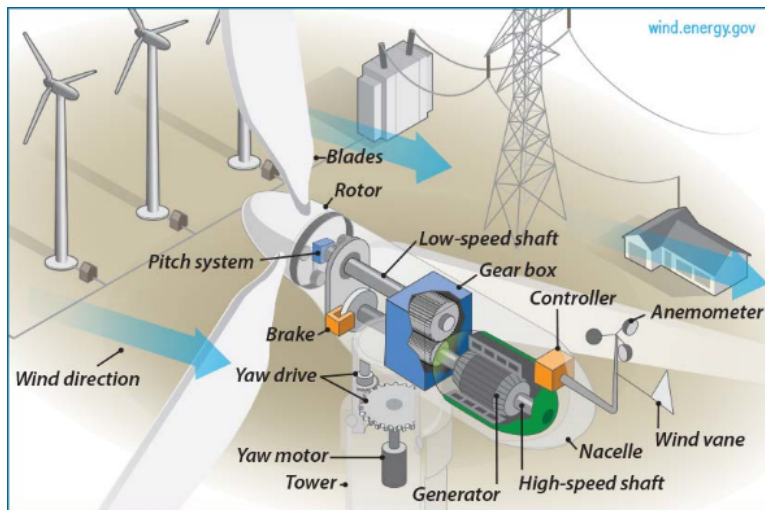


Name: _____

Activity - WIND TURBINE DESIGN CHALLENGE

Task:

Design and create a wind turbine that can lift a weight up 30 centimetres high.



1. Research:

- How do wind turbines work?
- What parts will I need to have?
- How will I convert wind into mechanical energy?
- What simple machines could I use?

2. Imagine:

- Brainstorm possible ideas & materials.

3. Plan:

- Sketch out your designs.
- Make a list of materials.

4. Create:

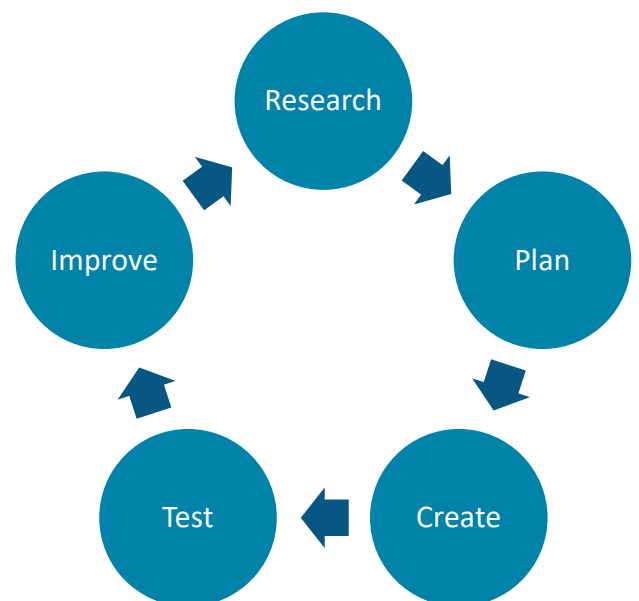
- Build a prototype!

5. Test:

- Practice, observe, analyze.

6. Reflect/Improve:

- What went wrong? What went right? Why?





Name: _____

Criteria:

1. All materials are to be reused, recycled or already found at home or school. No purchased materials
2. You may work individually or with a partner
3. No more than 50% of your project may be completed at home
4. Your wind turbine may not be taller than 50 cm
5. You may share materials if you want, but don't have to
6. You must show evidence of research (point form notes)
7. You must show evidence of brainstorming and planning (on the designated sheet)
8. You must have reflections/observations (drawing, written)

Research:

Guiding Questions:

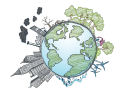
- How do windmills and wind turbines work?
- What parts will I need to have in my design? (base, tower, blades, shaft, etc.)
- What is the best angle (pitch) to have my blades?
- How will I convert wind energy (kinetic energy) into mechanical energy electricity?
- What simple machines could I use? (Pulleys, gears, wheel and axle, lever)

Websites to Use:

Google Search Results for "build a wind turbine that lifts a weight."

- <https://www.energy.gov/eere/wind/how-do-wind-turbines-work>
- <https://www.youtube.com/watch?v=DILJJwsFI3w>
- https://www.youtube.com/watch?time_continue=7&v=MXVRmOc6Ni8

Research:



Brainstorming and Planning:

Design:

Materials

-
-
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Observations and Reflections:

1. How did you convert wind power into mechanical energy?
2. What went well for you?
3. What were some challenges you had to overcome?
4. What parts of your design did you change or modify and why?
5. What would you do differently next time?

Name: _____

Wind Turbine Design Challenge Rubric:

Criteria	E	C	M	N
Wind turbine Construction	Wind turbine is a solid model that withstood all testing, highly durable and reliable.	Wind turbine is a sturdy model that withstood multiple tests, durable and reliable.	Wind turbine is a working model that withstood multiple tests, somewhat durable and reliable.	Wind turbine is not a working model. It did not withstand multiple tests, not durable or reliable.
Wind turbine Design	Design is highly creative and original.	Design is somewhat creative and original.	Design is much like others.	Design lacks creativity and is not original.
Project Management	Students worked well in a group/individually, no support was required, handed in on time and all components were completed.	Students worked well most of the time, infrequent interventions required, handed in on time and all components were completed.	Students worked well some of the time, frequent interventions required, handed in on time and all components were completed.	Students did not work well and required constant interventions, not complete and required more time to complete.
Research	Ideas and concepts are highly detailed and clear, shows an exemplary understanding.	Ideas and concepts are detailed and clear, shows a commendable understanding.	Ideas and concepts are somewhat developed, shows a sufficient understanding.	Ideas and concepts are unclear and underdeveloped, shows an insufficient understanding.
Planning	Clear evidence of excellent planning both written and schematic, highly detailed and organized.	Evidence of solid planning both written and schematic, detailed and organized.	Some evidence of planning, somewhat detailed and organized.	No clear evidence of planning.
Reflections	Reflections and observations are highly detailed and thoughtful.	Reflections and observations are detailed and thoughtful.	Reflections are basic, somewhat detailed and thoughtful.	Reflections are missing, incomplete or insufficient.
Overall Mark				

Comments: