



JOHN EDMONDSON HIGH SCHOOL

Assessment Notification

Faculty: Industrial Arts Course: Engineering Studies Year: 10

Assessment Task: Alternative Energy Practical and Report

Assessment Weighting: 35% Due: Term 2 Week 2 Date: 5/05/2023

Task Type: Hand in Task In Class Task Practical Task

Outcomes assessed (NESA)
Understands and applies safe work practices in practical environment
Uses a range of materials, tools and techniques in the production of practical projects
Evaluates products in terms of functional, economic, aesthetic and environmental qualities
Communicates effectively using a range of graphical and written methods
Task Description/Overview
Engineering report on the production of your wind turbine – SUBMIT VIA CANVAS
Detailed Assessment Task Description
Students are to produce an engineering report by documenting the following: <ul style="list-style-type: none"> • Identify and research the need or problem • Develop and select the best possible solutions • Construct the prototype • Test and evaluate the solution • Communicate the solution • Redesign

Assessment Criteria		
Grade	Description	Mark Range
Outstanding (O)	The student has an extensive knowledge and understanding of the content and can readily apply this knowledge. In addition, the student has achieved a very high level of competence in the processes and skills and can apply these skills to new situations.	45-50
High (H)	The student has a thorough knowledge and understanding of the content and a high level of competence in the processes and skills. In addition, the student is able to apply this knowledge and these skills to most situations.	40-44
Sound (S)	The student has a sound knowledge and understanding of the content and has achieved a good level of competence in the processes and skills.	30-39
Basic (B)	The student has a basic knowledge and understanding of the content and has achieved a basic level of competence in the processes and skills.	15-29
Limited (L)	The student has an elementary knowledge and understanding in a few areas of the content and still required further work to achieve competence in the processes and skills.	0-14

Satisfactory completion of courses

A course has been satisfactorily completed, when the student has:

- Followed the course developed/endorsed by the NSW Educational Standards Authority (NESA)
- Applied himself/herself with diligence and sustained effort to the set tasks and experiences provided in the course.
- Achieved some or all of the course outcomes

POWER YOUR HOUSE WITH WIND ENERGY

You will learn how engineers harness the energy of the wind to produce power by following the engineering design process as you prototype a wind turbine and test to see the factors that affect its output. You will also learn how engineers decide where to place wind turbines, and the advantages and disadvantages to using wind power compared to other non-renewable energy sources.

Engineering Connection

Engineers are responsible for developing, designing, testing and improving ways in which electricity is generated for our homes and businesses. One way to generate power is to harness the energy of the wind using a wind turbine. Engineers are responsible for the design, implementation and testing of wind turbines all over the world. Civil, mechanical and electrical engineers work together to determine the most ideal locations for wind farms and the most efficient turbine designs for specific conditions.



Learning Objectives

After this activity, students should be able to:

- Describe how wind turbines transfer the energy of the wind into electricity.
- List several advantages and disadvantages for using wind power.
- Use the engineering design process to create prototype wind turbines.

Materials List

Each group will need:

- A 5-10 cm long block of cylindrical wood, at least 1.9 cm in diameter, for the horizontal-axis turbine

For the entire class to share:

- 1-2 multimeters or voltmeters
- 2 double-ended alligator clip wire test leads
- 1-2 DC motors (available at RadioShack [suggested part numbers: 273-223, 273-047, or 273-106] or hobby stores; make sure the shaft does not have a gear on it.)
- drill
- drill bit equal to the diameter shaft of the hobby motor
- 2 blocks of 2 x 4 wood, each about 12.7 cm long
- two 6.35 cm nails or screws
- hammer or screwdriver
- various materials from which to construct turbine blades, such as foam core board, index cards, plastic bottles, cardboard, particle board, thick poster board, foam board, thin dowel rods, bamboo skewers, etc.

- scissors
- glue
- strong tape, such as duct tape or packing tape
- house or box fan with three-speed settings

Introduction/Motivation

- Wind is a terrific renewable energy source because as long as the sun is shining, there will be wind, and as long as there is wind, there is energy. You will build a horizontal axis wind turbine and then testing the design to see how it performs. Throughout this process you will follow the same steps that engineers follow in the design process; you will brainstorm ideas, design and build the wind turbines, test them, and analyze the data you collect to make a final decision about which factors affect the performance of the wind turbine.

Students will:

1. Arrange themselves into groups of two or three students each.
2. Using your creativity, generate a problem that you are trying to solve by designing wind turbines; this should include how to generate electricity for a house using a renewable energy source.
3. In your group, brainstorm designs for a horizontal-axis turbine. Possible questions to ask yourself: How many blades? How to space them? From what material should you make the blades? What shape for the blades? Record all your brainstorm ideas on a blank piece of paper.
4. From a review of your brainstorming exercise results, choose one design to build for your wind turbine models. Draw your designs to scale on a blank piece of A4 or A3 paper and explain why you chose that design.
5. Next, each group will begin constructing their turbines. Use a short cylindrical wood block for the wind turbine. Attach the turbine blades onto the side of the wood opposite the side with the hole drilled into it.
6. [Optional] Once you have finished building your designs, test them. To do this, stick the end of the model turbine through the PVC pipe on the testing device and onto the shaft of the motor. You may want to tape the front end of the testing device to the surface it is sitting on in order to prevent movement during testing. Once the turbine is connected, one student is to operate the fan at each speed setting.
7. [Optional] Each group will take turns testing their turbine designs at three different fan speeds, recording the output data.
8. Conclude with a discussion to review and compare your groups' findings. What improvements would you make? Where would you locate turbines near your energy-efficient houses?

Post-Activity Assessment

Discussion:

- What parts of your designs seemed to result in greater efficiencies of converting the kinetic energy of the wind into electrical energy?
- In what ways could improvements be made to increase the efficiency of your turbines?
- What effect would incorporating aerodynamics into your designs have on the performance of your turbines?

Engineering Report:

You are to write up an Engineering Report on your findings. To do this, you should follow the Engineering Design Process (handed out to you earlier in the Term) documented below. This is just a basic guide.

1. Identify the Need or Problem:

- Generate a problem that you are trying to solve by designing wind turbines.
- Discuss the effects that the construction of a wind turbine has on society and the environment

2. Research the Need or Problem:

- How does wind get generated?
- How is wind used to generate electricity/energy?
- What are the factors that affect the efficiency of wind turbine design?
- Include the type of engineers that are involved in designing wind turbines and what their role is

3. Develop Possible Solutions:

- Provide 2 sketches of each wind turbine design. This must be neatly drawn using pencil.

4. Select Best Possible Solution

- Draw your final intended design to scale on A4 paper
- Your final design should be aesthetically pleasing.

5. Construct a Prototype:

- Layout the method you used in constructing your wind turbine
- Create a computer-generated model using Onshape
- A photograph of the final model

6. Test and Evaluate Solution:

- What difficulties did you encounter during the engineering process?
- What did you learn by working in a team?

7. Communicate the solution

- Your solution will be communicated via this engineering report

8. Redesign:

- How can you improve the design based on the things you learned from testing

MARKING CRITERIA:

Identify Need or Problem	Excellent in-depth discussion of the effects of constructing a wind turbine on society and environment. (10 marks)	Reasonable discussion on the effects of constructing a wind turbine on society and environment. (8 marks)	Brief discussion on the effects of wind turbine construction on society and environment. (6 marks)	Provides only positive or negative effects on wind turbine construction on society and environment. (4 marks)	Brief mention of positive or negative effects on wind turbine construction on society and environment. (2 marks)
Research	An in-depth response to the 4 dot points (prev page) (10 marks)	An in-depth response to 3 dot points (prev page) (8 marks)	An in-depth response to 2 dot points (prev page) (6 marks)	A brief response to the 3-4 dot points (prev page) (4 marks)	A brief response to 2 or less dot points (2 marks)
Possible Solution		Provides 2 neatly drawn sketches (4 marks)	Provide 2 rough sketches of design (3 marks)	Provide 1 neatly drawn sketch (2 marks)	Provides 1 rough sketch of design (1 mark)
Best Possible Solution				Provides a well-drawn to scale design on A4 or A3 paper (3 marks)	Provides a messy and not to scale design (1-2 marks)
Prototype Construction		Well written and step by step method with a picture of final model attached (4 marks)	Adequately written and step by step method with picture of final model attached (3 marks)	Brief method with a picture of final model attached (2 marks)	No method written and picture of final model attached (1 mark)
Test and Evaluate solution		Well written account of the difficulties you encountered. State the lessons you learnt by working in a team (4 marks)	Brief account of the difficulties you encountered. State the lessons you learnt by working in a team (3 marks)	States the lessons learnt by working in a team in a concise and accurate manner (2 marks)	Briefly states the lessons learnt by working in a team (1 mark)
Communicate solution				Presentation follows report guidelines and is well laid out Communication uses diagrams, pictures & is well referenced. (5 – 10 marks)	Inaccurate de of an engineering report with no diagrams and references (1-4 marks)
Redesign	Multiple in-depth methods of how the design can be improved after testing (5 marks)	Multiple brief methods of how the design can be improved after testing (4 marks)	1 In-depth method of how to improve design after testing (3 marks)	1 brief method of how to improve design after testing (2 marks)	Attempts to give a method of how to improve design after testing (1 mark)
				TOTAL	/50

