

**GOLD
SEAL
LESSON**

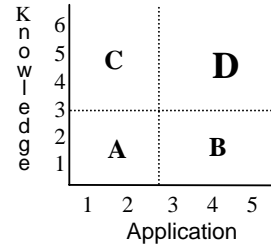


Wind Power Feasibility Study

Career Cluster: Agriculture

Subject(s)
Engineering and Design

Rigor/Relevance Framework



Grade Level 11–12

Instructional Focus

Reading: Students read a variety of grade level materials, applying strategies appropriate to various situations
Writing: Students write for a variety of purposes and audiences with sophistication and complexity appropriate to the grade level.
Speaking: Students speak for a variety of purposes and audiences with sophistication and complexity appropriate to the grade level.
Measurement: Students use a variety of tools and techniques of measurement in a problem-solving situation. Students communicate the reasoning used in solving these problems.
Basic Concepts and Knowledge: Students develop an understanding of scientific concepts using facts, theories, principles, and models.
Communication: Students communicate and apply scientific concepts.
Science in Personal and Social Perspectives: Students apply scientific principles to personal and social issues.

Student Learning

- Students will conduct research on generating wind power.
- Students will create a PowerPoint presentation.
- Students will design experiments to collect wind velocity data.
- Students will use maps of the project area to identify optimal turbine locations.
- Students will visually survey the project area to recognize potential environmental impacts to sensitive habitats.
- Students will make specific recommendations based on research.
- Students will justify their decisions with sound scientific information.
- Students will present information in a formal written report.

Performance Task

Overview
 Students will work in small groups as renewable energy consultants specializing in wind power. Students will make PowerPoint presentations to the “Board of Education” to win a contract to develop wind power on the grounds of their school. Students will conduct Internet research and collect experimental data to make sound recommendations to the Board. Students will present their recommendations in a formal written report complete with maps, schematics, graphs and tables.

Performance

Description
 Students will work with a partner or small group to act as renewable energy consultants who have been contracted by the school district to investigate the potential use of wind power to supplement the school’s energy use. The project

Task
(con't)

will be completed in two phases.

Phase 1

The school district would like the consulting team to make a presentation to the Board of Education to inform them on the basics of wind power generation. The board is also interested in what information would have to be collected in order to make an informed decision on the feasibility of using wind power at the school.

The firm with the best overall presentation will be awarded the construction contract and hired by the school district to complete the project.

The consulting team will create a PowerPoint presentation on the basics of wind power and the mechanical operation of wind turbines to give the board the background information they will need.

Students will conduct Internet research to gather the information they will need to make the presentation. Another possibility is for students to contact a consulting firm specializing in wind energy to gather pertinent information.

Students will also need to include a plan that outlines all of the information they will need to gather and the testing they will need to conduct in order to fully evaluate whether a project of this nature will be in the district's best interest.

This should include, but not be limited to information on:

- topography of site
- wind potential—anemometer readings over an extended period
- environmental impacts—wetlands, habitat, neighbors
- construction constraints
- energy use by the school
- cost-benefit analysis
- type of turbine
- size of generating unit (electrical output)
- rotor blade shape
- optimal height of tower
- number of propose turbines

Each student team will then turn in their PowerPoint presentation to the teacher who will evaluate it against the checklist for Phase 1.

Phase 2

Students will meet briefly with their teacher to receive feedback on their presentation. Next, students will be required to actually collect as much data as possible on the information outlined in their proposal from Phase 1.

Recommended data collection: not to be shared with students right away. Allow students to develop their own plan of attack for this task. If they are really struggling, teachers may decide to assist them with some specific recommendations.

Students should set up a wind sock to identify prevailing wind direction to orient turbines correctly. Students should take anemometer readings over a 7- to 10-day period to judge if wind velocity will be adequate. Access topographic maps of the site to determine the optimal location of the turbines based on elevation. Visually

Performance

Task
(con't)

survey the site area to determine if sensitive habitats would be impacted by the project.

Learn how much electricity the school actually uses and research the most appropriate turbines for the job. Gather technical specifications on a variety wind turbines that would be appropriate for the districts needs.

Remind students that their consulting team is being “paid” by the school district to provide them with information, and the firm that does the best job will be awarded the construction contract and, more important, the best grade.

When students have gathered their information, they will organize it into a formal written report to the district with all of their data and recommendations. Students should include all maps, schematics, and experimental data collected during the activity.

Students will be required to justify all recommendations with data that has been gathered in a sound and responsible manner.

Essential Skills

- E6 Collect and focus thoughts about the writing activity (brainstorming, listing, drafting, etc.).
- E8 Prepare and deliver individual speeches that address the needs of the target audience by gathering information, rehearsing, making eye contact, speaking loudly enough, and delivering information in a well-organized fashion.
- E25 Write in various formats such as learning logs, laboratory reports, note-taking, response journals, organizers, and portfolios.
- S4 Make observations and accurate and precise measurements using senses, tools, and technology.
- S15 Plan and apply real or hypothetical models and constructions to facilitate short- and long-term investigation, learning, and solutions to practical problems, including experimental design that incorporates variables and a method for collecting fair and adequate data.
- S21A Compare and investigate various types of energy (e.g., heat. Light. Electromagnetic, nuclear, internal, wave, potential vs., kinetic) and energy transfer and know how to apply measurements of energy.

Scoring Guide

Attached

**Attachments/
Resources**

Phase 1 Checklist

Submitted by: James M. Carey, Canajoharie High School, Jcarey@canajoharie.k12.ny.us

Scoring Guide

Rate student performance on each item using the following method:

4 Points: The student demonstrates a high-quality performance and presentation of new knowledge and skills.

3 Points: The student demonstrates a good application of new knowledge and skills.

2 Points: The student demonstrates an appropriate application of new knowledge and/or skills, which is technically correct.

1 Point: The student demonstrates minimally acceptable application of new knowledge and/or skills.

Item	Rating (circle one)			
Student is clear, articulate, well rehearsed, and informative during PowerPoint presentation demonstrating a high level of conscientious effort.	1	2	3	4
PowerPoint presentation is complete, thorough, and professional. Student has incorporated appropriate diagrams, graphs, and explanations.	1	2	3	4
Student's plan for additional information as outlined in Phase 1 incorporates most of the information from the checklist indicating thorough research and a solid understanding of the task at hand.	1	2	3	4
Student collects experimental data in a sound scientific manner. Wind velocity readings are taken correctly over several days, and prevailing wind direction is correctly identified.	1	2	3	4
Student provides a thorough survey of the site location and identifies all potential habitats that may be affected.	1	2	3	4
Student provides exceptional technical information on specific wind turbines and justifies his/her decision on which type would best meet the school's needs with sound reasoning.	1	2	3	4
Student uses topographic maps to appropriately position turbines in the best possible location and demonstrates an understanding of the relationship of wind velocity and elevation.	1	2	3	4
Final report is well organized, clearly written, and informative.	1	2	3	4
Report includes all necessary graphs, tables, schematics, etc. in a professionally looking fashion.	1	2	3	4
Student justifies all recommendations in the report with sound reasoning and technical information.	1	2	3	4
Student worked cooperatively within the group environment and made significant contributions to the project.	1	2	3	4

Phase 1 Checklist

Teachers may wish to develop their own checklist that includes specific aspects that are emphasized during your own course.

The checklist is designed to measure how thorough student groups think through the activity and should not be shown to students prior to their PowerPoint presentation.

- _____ 1. Topography of site: Students access accurate maps and make informed decisions on turbine placement that uses the highest accessible elevation to maximize wind speed.
- _____ 2. Wind potential correctly assessed: Students plan and record anemometer readings over an extended period. Students use a wind sock or series of observations to correctly identify the prevailing wind direction.
- _____ 3. Environmental impacts: Students recognize environmental impacts to sensitive wetlands and other habitats, as well as concerns of homeowners that live close by.
- _____ 4. Energy use by the school: Students gather accurate data on energy consumption and cost to the district over the past year.
- _____ 5. Cost-benefit analysis: Students prepare a fairly comprehensive analysis that shows an estimated cost of the turbine project construction and its projected savings over time to the district.
- _____ 6. Type of turbine: Students research a variety of turbines and choose the most appropriate models for the proposed energy output.
- _____ 7. Size of generating unit: Students collect technical data on generating units (electrical output, gear ratio, etc.).
- _____ 8. Rotor blade shape: Students address the two types of designs and correctly compare and contrast the operation of each.
- _____ 9. Optimal height of tower: Students use wind velocity data to choose the optimal height of the tower to maximize wind velocity but minimize materials cost.
- _____ 10. Number of proposed turbines: Students make an informed decision on the number of turbines required for the energy output desired.