Wind Turbines

Content Area: **Science**
Course(s): **CP Introduction to Engineering**
Time Period: **Marking Period 1**
Length: **3.5 weeks**
Status: **Published**

Course Pacing Guide

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Unit	MP/Trimester	Weeks
Wind Turbines	1	3.5

Unit Overview

In this unit, students will work in a team to design and construct a wind turbine. Students will learn about wind turbines and their power output based on gear ratios as well as blade design. They will then be provided with the design restrictions and the available materials for their design. Each team will have to produce a design on paper with an appropriate scale and key before they begin construction. Once they have constructed their prototype they will test it, collect data and analyze their results. Based on their preliminary findings they will then make adjustments to one aspect of their design and retest. This may occur several times so the students can optimize their design. Each group will then present their design to the client (teacher) as well as test the power output of their wind turbine in the wind tunnel against the other groups. A detailed report containing the design changes as well as the results from their testing phase will be included in this unit.

Enduring Understandings

Students will understand the effect of different gear ratios on the tradeoff between power and speed.

Students will understand the effect of the angle of incidence of wind on energy production.

Essential Questions

What is the effect of different gear ratios on the tradeoff between power and speed?

What is the effect of the angle of incidence of wind on energy production?

New Jersey Student Learning Standards (No CCS)

SCI.9-12.5.1.12 A.3*- [Cumulative Progress Indicator] - Engage in collaboration, peer review, and accurate reporting of findings.*

SCI.9-12.5.1.12B.2 - *[Cumulative Progress Indicator] -Show* that experimental results can lead to new questions and further investigations.

9-12.HS-ETS1	Engineering Design
9-12.HS-ETS1-1.1	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
9-12.HS-ETS1-1.1.1	Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
9-12.HS-ETS1-1.ETS1.A	Defining and Delimiting Engineering Problems
9-12.HS-ETS1-1.ETS1.A.2	Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
9-12.HS-ETS1-2.ETS1.C.1	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
9-12.HS-ETS1-3.6.1	Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Amistad Integration

The Amistad Bill (A1301), which became law in 2002, calls on New Jersey schools to incorporate African-American history into their social studies curriculum.

This course does not fall in this category.

Holocaust/Genocide Education

a. Every board of education shall include instruction on the Holocaust and genocides in an **appropriate place in the curriculum** of all elementary and secondary school pupils.

This is not the approprate place for this educational piece.

Interdisciplinary Connections

TECH.8.1.12.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.12.B.CS2	Create original works as a means of personal or group expression.
TECH.8.1.12.A	Students demonstrate a sound understanding of technology concepts, systems and operations.
9-12.HS-ETS1	Engineering Design
9-12.HS-ETS1-1.1	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

Technology Standards

TECH.8.2.12.D.6	Synthesize data, analyze trends and draw conclusions regarding the effect of a technology on the individual, society, or the environment and publish conclusions.
TECH.8.2.12.D.5	Explain how material processing impacts the quality of engineered and fabricated products.
TECH.8.2.12.D.1	Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.

21st Century Themes/Careers

CAEP.9.2.12.C.3	Identify transferable career skills and design alternate career plans.
CAEP.9.2.12.C	Career Preparation

Financial Literacy Integration

1. The State Board of Education shall require that a school district incorporate in each of the grades [1][kindergarten] six[1] through eight financial literacy instruction to pupils enrolled in those grades. The purpose of the instruction shall be to provide [1][elementary and][1]middle school students with the basic financial literacy necessary for sound financial decision-making.

This course does not fall in this category.

Instructional Strategies & Learning Activities

In this unit, students will work in a team to design and construct a wind turbine. Students will learn about wind turbines and their power output based on gear ratios as well as blade design. They will then be provided with the design restrictions and the available materials for their design. Each team will have to produce a design on paper with an appropriate scale and key before they begin construction. Once they have constructed their prototype they will test it, collect data and analyze their results. Based on their preliminary findings they will then make adjustments to one aspect of their design and retest. This may occur several times so the students can optimize their design. Each group will then present their design to the client (teacher) as well as test the power output of their wind turbine in the wind tunnel against the other groups. A detailed report containing the design changes as well as the results from their testing phase will be included in this unit.

Differentiated Instruction

- Curriculum Map
- Inquiry/Problem-Based Learning
- Learning preferences integration (visual, auditory, kinesthetic)
- Tiered Learning Targets
- Learning through play
- Relationship-Building & Team-Building
- Self-Directed Learning
- Debate
- Student Data Inventories
- Mastery Learning (feedback toward goal)
- Goal-Setting & Learning Contracts
- Grouping
- Rubrics
- Flipped Classroom
- Mentoring

Formative Assessments

Students test, make changes based on their results and retest multiple times during the course of this project, so they are constantly provided with a formative assessment of their progress.

Summative Assessment

On the final day, students present their windturbine, place it infront of the wind generator and displat the voltage they are able to produce. After the project, students write a lab report that details all of the variations they tested throughout the project and the results from each test. They also need to produce an optimization graph showing the voltage produced at several different angles. They also need to write a thorough reflection including assumptions they had coming into this project and how those assumptions changed based on their testing, what difficulties they had and how they were able to overcome those difficulties.

Benchmark Assessments

Students test, make changes based on their results and retest multiple times during the course of this project, so they are constantly provided with benchmark assessments of their progress.

Alternate Assessments

This project is based on the concept of an alternative assessment. They are being assessed on what they are able to build and how they are able to reflect on this process.

Resources & Technology

Their resources are the research they did at the beginning on wind turbines and the KidWind kit they were provided with.

BOE Approved Texts

The BOE approved this text when the class was adopted in 2012

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Closure

There is a reflection that students write that allows them to explain what they learned about gear ratios and blade design through this project and also to write about what problems they incurred and how they were able to overcome these challenges.

ELL

- Teacher Modeling
- Group work
- Simplified Written and Verbal Instructions
- Google Translate

Special Education

- Specify and list exactly what the student will need to learn to pass.
- Evaluate the classroom structure against the student's needs (flexible structure, firm limits, etc.).
- Keep workspaces clear of unrelated materials.
- Reduce visual distractions in the classroom (mobiles, etc.).
- Provide a computer for written work.
- Seat the student close to the teacher or a positive role model.
- Provide an unobstructed view of the chalkboard, teacher, movie screen, etc.
- Keep extra supplies of classroom materials (pencils, books) on hand.
- Maintain adequate space between desks.
- Give directions in small steps and in as few words as possible.
- Number and sequence the steps in a task.

- Have student repeat the directions for a task.
- Provide visual aids.
- Go over directions orally.
- Allow the student to complete an independent project as an alternative test.
- Grade spelling separately from content.
- Show a model of the end product of directions (e.g., a completed math problem or finished quiz).
- Stand near the student when giving directions or presenting a lesson.

504

- preferential seating
- extended time on tests and assignments
- modified textbooks or audio-video materials
- behavior management support
- excused lateness, absence, or missed classwork

At Risk

- Have student restate information
- Provision of notes or outlines
- Concrete examples
- Assistance in maintaining uncluttered space
- No penalty for spelling errors or sloppy handwriting
- Follow a routine/schedule
- Teach time management skills
- Verbal and visual cues regarding directions and staying on task
- Visual daily schedule
- Immediate feedback
- Work-in-progress check
- Pace long-term projects
- Cue/model expected behavior
- Use de-escalating strategies
- Use peer supports and mentoring
- Chart progress and maintain data

Gifted and Talented

Focus on effort and practice

Offer the Most Difficult First

Offer choice

Speak to Student Interests

Allow G/T students to work together

Encourage risk taking