PATHWAY: Engineering

COURSE: Foundations of Engineering and Technology

UNIT: 12. Energy and Power Systems

INTRODUCTION

Annotation: Briefly describe the unit topics, tasks, methods, etc.

In this unit students will demonstrate an understanding of the important terminology and major concepts involved in energy and power systems. Students will use PowerPoint to create a presentation and Excel to create a spreadsheet to model data. They will also apply that knowledge in the creation of a technological device capable of meeting specific design criteria.

Grade(s):

X	9th
X	10th
X	11th
X	12th

Time:

10 Hours

Author:

Cameron Smith

Students with Disabilities:

For students with disabilities, the instructor should refer to the student's IEP to be sure that the accommodations specified are being provided. Instructors should also familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation.

Notes to the Teacher:

- This unit includes the Mousetrap Vehicle activity. You may design the activity to use kits or simply purchase the necessary part separately. Other activities may be substituted instead.
- Text: Schwaller, Anthony E. (1989) Transportation, Energy, and Power Technology, Delmar Publishers, Inc. Albany, NY.

FOCUS STANDARDS

GPS Focus Standards: Please list the standard and elements covered.

- ENGR-FET-1d – Participate in hands-on activities related to multiple engineering and technology pathways.
- ENGR-FET-2a – Identify key historical events and their impact on engineering and technology.
- ENGR-FET-2b – Describe the issues of wealth, fame, power, and necessity that have influenced innovation and technological development.
- ENGR-FET-2d – Describe the impact of governmental and political systems on technological innovation.
- ENGR-FET-2e – Explain the interaction between technological development and social change.
- ENGR-FET-3a – Describe the processes of input, processing, output, and feedback that comprise the universal systems model.
- ENGR-FET-3b – Demonstrate applications of the universal systems model across the spectrum of technologies.
- ENGR-FET-4 – Students will apply mathematics and science to the solution of a technological problem.
- ENGR-FET-5a – Explain the problem solving processes used by engineers, designers, and other technologists.
- ENGR-FET-5b – Demonstrate creative approaches to problem solving.
- ENGR-FET-5c – Create a solution to a given problem.
- ENGR-FET-5d – Test and evaluate a problem solution.
- ENGR-FET-5e – Implement a problem solution.
- ENGR-FET-6 – Students will use visual and verbal communication to express basic design elements.
- ENGR-STEM-1 – Students will recognize the systems, components, and processes of a technological system.
- ENGR-STEM-2 – Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts.
- ENGR-STEM-3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.
- ENGR-STEM-4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.
- ENGR-STEM-5 – Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.

- ENGR-STEM-6 – Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.
- ENGR-STEM-7 – Students will develop leadership and interpersonal problem-solving skills through participation in co-curricular activities associated with the Technology Student Association.
- CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.
- CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.
- CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.
- CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.
- CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.
- CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.
- CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.
- CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

GPS Academic Standards:

- MM3P1. Students will solve problems (using appropriate technology).
- MM3P3. Students will communicate mathematically.
- MM3P4. Students will make connections among mathematical ideas and to other disciplines.
- SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
- SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.
- ELAALRC3. The student acquires new vocabulary in each content area and uses it correctly.

National / Local Standards / Industry / ISTE:

UNDERSTANDINGS & GOALS

Enduring Understandings: Enduring understandings are statements summarizing important ideas and have lasting value beyond the classroom. They synthesize what students should understand – not just know.

Students will learn how energy and power contribute to modern society, and why it is essential for engineers to understand energy and power.

Essential Questions: Essential questions probe for deeper meaning and understanding while fostering the development of critical thinking and problem-solving skills. Example: Why is life-long learning important in the modern workplace?

- What are the 6 forms of energy?
- What are the laws of energy conservation?
- How is technology used to convert energy into power?
- How is horsepower measured?

Knowledge from this Unit: Factual information.

Students will:

- Be able to demonstrate their knowledge of the six forms of energy and how energy is used to create power in technological devices.
- Be able to explain the universal systems model in terms of energy and power technology.
- Demonstrate the ability to use common terms and mathematical formulas associated with energy and power.
- Be able to create and analyze data sets based on their lab activities.
- Be able to apply their knowledge of mechanical power systems in the context of a design problem.

Skills from this Unit: Performance.

ASSESSMENT(S)

Assessment Method Type: Select one or more of the following. Please consider the type(s) of differentiated instruction you will be using in the classroom.

_____ Pre-test
X Objective assessment - multiple-choice, true- false, etc.
__ Quizzes/Tests
__ Unit test
_____ Group project
_____ Individual project
X Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
__ Self-check rubrics
__ Self-check during writing/planning process
__ Journal reflections on concepts, personal experiences and impact on one's life
__ Reflect on evaluations of work from teachers, business partners, and competition judges
__ Academic prompts
__ Practice quizzes/tests
_____ Subjective assessment/Informal observations
__ Essay tests
__ Observe students working with partners
__ Observe students role playing
_____ Peer-assessment
__ Peer editing & commentary of products/projects/presentations using rubrics
__ Peer editing and/or critiquing
_____ Dialogue and Discussion
__ Student/teacher conferences
__ Partner and small group discussions
__ Whole group discussions
__ Interaction with/feedback from community members/speakers and business partners
_____ Constructed Responses
__ Chart good reading/writing/listening/speaking habits
__ Application of skills to real-life situations/scenarios
_____ Post-test

Assessment(s) Title:

Reflection Paper

Assessment(s) Description/Directions:

Require each student to reflect on the lessons learned in the Mousetrap Car Activity. This activity should be guided by a rubric which details the vocabulary words, formulas, concepts, etc. that are required to be discussed in the reflection. The requirements for this paper should include the enduring concepts and terminology that students should acquire from the activity.

Attachments for Assessment(s): Please list.

- Mouse Trap Car Teacher Guide
- Mouse Trap Car Activity
- Mouse Trap Car Race Rules
- Mouse Trap Car MESA Rules

LEARNING EXPERIENCES

Instructional planning: Include lessons, activities and other learning experiences in this section with a brief description of the activities to ensure student acquisition of the knowledge and skills addressed in the standards. Complete the sequence of instruction for each lesson/task in the unit.

Sequence of Instruction

1. Identify the Standards. Standards should be posted in the classroom for each lesson.

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2. Review Essential Questions.

- What are the 6 forms of energy?
- What are the laws of energy conservation?
- How is technology used to convert energy into power?
- How is horsepower measured?

3. Identify and review the unit vocabulary.

4. Assessment Activity.

- Day 1 Lecture 1: Introduction to concepts and terminology *(with lecture notes worksheet)*
  - Assign PowerPoint over major concepts/terminology
- Day 2 Lecture 2: Additional concepts and terminology *(with lecture notes worksheet)*
  - Students finish PowerPoint over major concepts/terminology
- Day 3 Lecture 3: Building the Tension Wheel
  - Lab Activity 1 – Building a Tension Wheel *(see attachment)*
- Day 4 Lecture 4: Calculating Spring Constant
  - Lab Activity 2 – Calculating Spring Constant *(see attachment)*
- Day 5: Mousetrap Vehicle Construction Day 1
- Day 6: Mousetrap Vehicle Construction Day 2
- Day 7: Mousetrap Vehicle Construction Day 3
- Day 8: Lecture 5: Using Excel for Analyzing Data in Engineering *(see Excel Spreadsheet Web Resource above)*
  - Lab Activity 3 – Data Collection using Mousetrap Vehicle, Optimization of designs
- Day 9: Students demonstrate Mousetrap Vehicle
- Day 10: Culminating assessment

Attachments for Learning Experiences: Please list.

Transportation Quiz

Notes & Reflections: May include notes to the teacher, pre-requisite knowledge & skills, suggestions, etc.

CULMINATING PERFORMANCE TASK (Optional)

Culminating Unit Performance Task Title:

Transportation History PowerPoint

Four Stroke-Cycle Engine PowerPoint

Transportation Activity

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Each student (or pair of students) should be assigned a transportation technology. They should then research and report on 10 iterations of this technology that have been developed over time. For each of the iterations, students should create 1 PowerPoint slide that includes a picture of the assigned technology, the year it was developed, and 3-4 sentences describing the new innovations that were part of this iteration. Including the title slide each presentation should be 11 slides in length.

Rubric for Performance Task: Please list.

The link below is a rubric for assessing student created PowerPoint Presentations:

http://www.uwstout.edu/soe/profdev/pptrubric.html

UNIT RESOURCES

Web Resources:

Helpful site for the **Mousetrap Vehicle** activity: http://www.docfizzix.com/design-help/index.shtml

Excel Spreadsheet resource site: http://techcenter.davidson.k12.nc.us/ruth/math/excel.htm

Attachment(s): Supplemental files not listed in assessment, learning experiences, and performance task.

What 21st Century Technology was used in this unit:

	Slide Show Software		Graphing Software		Audio File(s)
	Interactive Whiteboard		Calculator		Graphic Organizer
	Student Response System	X	Desktop Publishing		Image File(s)
	Web Design Software		Blog		Video
	Animation Software		Wiki		Electronic Game or Puzzle Maker
	Email	X	Website		