

PLTW Principles of Engineering (POE)

Curriculum/Content Area: Applied Technology & Engineering	Course Length: Two Terms
Course Title: Principles of Engineering (POE)	Date last reviewed: May 8, 2015
Prerequisites: Geometry, Introduction to Engineering Design	Board approval date: June 16, 2015

Desired Results

Course description and purpose:

This course investigates engineering and engineering technologies. It looks at how the tools of mathematical and scientific theory are integrated into functioning systems. Throughout the course various forms of technology are utilized, by the students, to create working solutions. This project work gives students the opportunity to develop skills and understanding of course concepts through activity-, project-, and problem-based (APPB) learning. Used in combination with a teaming approach, APPB learning challenges students to continually hone their interpersonal skills, creative abilities, and problem solving skills as they apply engineering concepts. It also allows students to develop strategies to enable and direct their own learning. A materials fee is charged for this course.

Enduring Understandings (EUs):

- Engineering is an ongoing process. The development of every new invention and innovation is grounded in the work of people from previous generations.
- Engineering is the profession in which the knowledge of the mathematics and natural sciences, gained by study, experience, and practice, is applied with judgment, to develop ways to utilize, the materials and forces of nature for the benefit of mankind.
- Ideas can be communicated in many different ways and the match between the selection of the form of communication and the audience determines the effectiveness of the presentation.
- A system is a group of related elements that work together for a specific outcome.
- Frequently problems are too complex for a single person to solve. Teams are formed and duties shared. It is important to have a diversified team to help discover solutions that someone might miss.
- Testing before, during, and after design & fabrication is essential to guaranteeing the reliability of a product.
- Reliability is the ability of a product to perform its designed function, within an acceptable

Essential Questions (EQs):

- Why is a design process, and the documentation of said process, so important to follow when creating a solution to a problem?
- How can an existing product be changed to incorporate different processes to make it less expensive and provide better performance?
- What emerging technologies are or may be on the horizon that will provide energy more efficiently?
- Why would an engineer use theory-based vs. experiment-based data interpretation in the decision-making process?
- Why are programmable logic devices used to control machines versus monitoring and adjusting processes manually?
- Why do teams use consensus to make decisions?
- Why are engineers concerned about material properties?
- Why do engineers and designers use scientific principles when creating solutions.
- Why is it crucial for designers and engineers to utilize statistics throughout the design process?

<p>tolerance, for a given length of time under specific operating conditions.</p> <ul style="list-style-type: none"> • Laws of physics exist, allowing for the prediction of actions between items within a system. These predictions are key elements in the overall design of a solution. 	
--	--

Assessment Evidence

<p>Performance assessments:</p> <ol style="list-style-type: none"> 1. Major projects consisting of: full project documentation, complete system design with modifications and fabrication of a functioning system prototype. 2. Project presentations targeted at either informing or persuading audiences about a design solution. 	<p>Other assessments:</p> <ul style="list-style-type: none"> • Formative activities including group work used to introduce content and provide feedback to students. • Summative quizzes used to determine content mastery.
---	---

Course-Wide Standards

Wisconsin Standards for Technology and Engineering:

ENG1: Students will analyze and demonstrate the attributes of design.

ENG2: Students will analyze and demonstrate engineering design.

ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.

ENG4: Students will develop abilities to apply the design process.

ENG5: Students will develop the abilities to use and maintain technological products and systems.

ENG6: Students will develop the abilities to assess the impact of products and systems.

Unit #1: Energy and Power

A. Mechanisms

B. Energy Sources

C. Energy Applications

D. Designing & Fabricating Energy & Power Systems

Standards

CCSS

CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Wisconsin Technology and Engineering Standards

ENG1.a.1.e: Design is a creative process.

ENG1.a.2.e: Everyone can design solutions to a problem.

ENG1.a.9.h: Examine how the design needs to continually be evaluated and the ideas of the design must be redefined and improved.

ENG2.a.2.e: Explore when designing an object, it is important to be creative and consider all ideas.

ENG2.b.3.m: Modeling, testing, evaluating and modifying are used to transform ideas into practical solutions.

ENG2.b.4.h: A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

ENG3.a.3.e: Explain troubleshooting is a way of finding out why something does not work so that it can be improved.

ENG4.a.3.m: Specify criteria and constraints for the design.

ENG4.b.2.e: Build or construct an object using the design process.

ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.

ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.

ENG5.a.7.h: Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

ENG5.b.2.e: Use computers and technology to access and organize information.

ENG5.b.5.m: Use computers, calculators and technology in various applications.

ENG5.b.8.h: Troubleshoot, analyze and maintain systems to ensure proper function, accuracy and precision.

Learning Targets

I can...

1. Apply concurrent engineering practices to solve problems.
2. Work effectively in teams and apply the design process to develop acceptable solutions to problems and case studies.
3. Apply appropriate design principles to create design solutions.
4. Develop and fabricate engineering systems in mechanical, thermodynamic, fluid, electrical, and control.
5. Determine the proper mechanical/electrical system to use in a compound machine design.
6. Analyze the overall system efficiency for a compound machine.

Unit #2: Materials & Structures

- A. Statics
- B. Material Properties
- C. Material Testing
- D. Structure Design & Fabricating

Standards

CCSS

CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Wisconsin Technology and Engineering Standards

ENG2.b.2.e: Discuss how models are used to communicate and test design ideas and processes.

ENG2.b.3.m: Modeling, testing, evaluating and modifying are used to transform ideas into practical solutions.

ENG3.b.2.e: Describe that the process of experimentation, which is common in science, can also be used to solve technological problems.

ENG4.b.2.e: Build or construct an object using the design process.

ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.
ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.
ENG5.b.2.e: Use computers and technology to access and organize information.
ENG5.b.5.m: Use computers, calculators and technology in various applications.
ENG6.a.2.m: Design and use instruments and technology to gather data.

Learning Targets:

I can...

1. Apply concurrent engineering practices to solve problems.
2. Work effectively in teams and apply the design process to develop acceptable solutions to problems and case studies.
3. Apply appropriate design principles to create design solutions.
4. Develop and fabricate engineering systems in mechanical, thermodynamic, fluid, electrical, and control.
5. Utilizing statics, mathematically analyze a system to determine the types and magnitude of forces within.
6. Explain the effects that stress has on a material and explain how the material will react.

Unit #3: Automation and Control Systems

- A. Machine Control
- B. Fluid Power
- C. Manufacturing Processes
- D. Statistics
- D. Designing & Fabricating an Automated System

Standards:

CCSS

CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Wisconsin Technology and Engineering Standards

ENG2.b.4.h: A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.

ENG3.a.3.e: Explain troubleshooting is a way of finding out why something does not work so that it can be improved.

ENG3.b.5.h: Describe how many technological problems require a multidisciplinary approach.

ENG4.b.2.e: Build or construct an object using the design process.

ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.

ENG5.a.3.e: Recognize and use everyday symbols such as numbers and symbols to communicate key ideas.

ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.

ENG5.a.7.h: Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

ENG5.b.2.e: Use computers and technology to access and organize information.

ENG5.b.5.m: Use computers, calculators and technology in various applications.

ENG5.b.8.h: Troubleshoot, analyze and maintain systems to ensure proper function, accuracy and precision.

Learning Targets:**I can...**

1. Apply concurrent engineering practices to solve problems.
2. Work effectively in teams and apply the design process to develop acceptable solutions to problems and case studies.
3. Apply appropriate design principles to create design solutions.
4. Develop and fabricate engineering systems in mechanical, thermodynamic, fluid, electrical, and control.
5. Develop, control and fabricate an automated system that is designed to perform a specific function within a specified tolerance.
6. Develop a mathematical estimation of a system's long-term performance.

Unit #4: Kinematics

- A. Kinematics
- B. Designing & Fabricating a Kinematic System

Standards**CCSS**

CCSS.ELA-Literacy.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

CCSS.ELA-Literacy.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Wisconsin Technology and Engineering Standards

ENG4.b.2.e: Build or construct an object using the design process.

ENG4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.

ENG4.c.3.e: Improve the design solutions.

ENG5.a.6.h: Diagnose a system that is malfunctioning and use tools, materials, or machines to repair it.

ENG5.b.2.e: Use computers and technology to access and organize information.

ENG5.b.5.m: Use computers, calculators and technology in various applications.

ENG5.b.8.h: Troubleshoot, analyze and maintain systems to ensure proper function, accuracy and precision.

Learning Targets:**I can . . .**

1. Apply concurrent engineering practices to solve problems.
2. Work effectively in teams and apply the design process to develop acceptable solutions to problems and case studies.
3. Apply appropriate design principles to create design solutions.
4. Develop and fabricate engineering systems in mechanical, thermodynamic, fluid, electrical, and control.
5. Determine the characteristics of a system involving an object in flight.