



Engineering I: Problem-Solving Through Design

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| Grade(s): | Grade 9- 12 |
| Discipline/Course: | Technology Education / Engineering |
| Course Title: | Engineering I: Problem-Solving Through Design |
| Prerequisite(s): | N/A |
| Course Description: <i>Program of Studies</i> | This course will engage student teams in the process of problem-solving, engineering challenges, and building machines. In this course, students learn and apply the engineering design process, proper tool usage, and basic building principles. While learning about mechanical and structural design, projects may include: trebuchets, mechanical arms, Rube Goldberg Machines, basic robotics. This is a great course for any student considering a career in engineering or robotics. |
| Course Essential Questions: | <ul style="list-style-type: none"> ● Why use engineering steps to solve a problem or improve upon an existing design? ● How are engineered systems created and tested in a team environment? ● Why do systems and circuits need to be designed, built, and tested? ● How can math, science, physics, and CAD be used to solve engineering problems? ● What purpose does competition play in improving engineering outcomes? |
| Course Enduring Understandings: | <ul style="list-style-type: none"> ● Following safety procedures and instructions is important in an Engineering Lab.. ● The Engineering process can be used to work through the design and fabrication of an idea to invent a device or process that improves society. ● An engineering report is used to collect data and analyze results. ● Fabrication skills and understanding processes are essential to allowing one to create an object, device, machine, etc. ● Solving problems and making decisions use critical thinking skills independently and in teams. |
| Duration/Credits: | One semester / .5 credit(s) |
| Course Materials/Resources: | Various electrical supplies, consumables, computers, fasteners. VEX Robotics Workcell Classroom kits. |

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| FPS Course Academic Expectation(s): | CC Creating and Constructing CI Conveying Ideas |
| Year at a Glance (Units) | Unit 1 - Introduction to Engineering (3 weeks) Unit 2 - Engineering Design Process (6-8 weeks) Unit 3 - Mechanical Systems (6-8 weeks) |

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| Unit Number and Title: | Unit 1 - Introduction to Engineering |
| Duration: | 3 weeks |
| Resource(s): | Various electrical supplies, consumables, computers, fasteners. VEX Robotics Workcell Classroom kits. |
| Unit Overview: | We will engage in the world of engineering by understanding its branches and potential careers. |
| Learning Goals | |
| Standard(s): | ENG.01 Identify the roles, responsibilities and requirements of engineering. ENG.06 Use engineering equipment, laboratory materials and tools appropriately and safely. ENG.07 Identify and demonstrate the use of various software programs used in the engineering field. ENG.08 Demonstrate the application of science and math principles to the electrical engineering process. |
| Essential Question(s): | <ul style="list-style-type: none"> ● What is engineering? ● What is technology? ● How is engineering knowledge created and communicated? ● What jobs exist in the field of engineering? ● What are the specific hazards and subsequent safety practices for robotics class and related environments? |
| Enduring Understanding(s): | <ul style="list-style-type: none"> ● There are many and varied engineering jobs and careers. ● An engineering notebook aids in design process documentation. ● A lab environment requires working in a safe and efficient manner. |
| Learning Goal(s): <i>Students will be able to use their learning to:</i> (Content/ Skills) | Content: (Students will know...) <ul style="list-style-type: none"> ● safety procedures and instructions. ● how to properly use an Engineering Design Notebook. ● potential careers in engineering. |

Skills: (Students will be able to...)

- practice safety procedures using lab equipment.
- write an engineering journal entry.
- list and explain different areas of engineering.
- define the importance of an engineering design team.

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| Unit Number and Title: | Unit 2 - Engineering Design Process |
| Duration: | 6-8 weeks |
| Resource(s): | Various electrical supplies, consumables, computers, fasteners. VEX Robotics Workcell Classroom kits. |
| Unit Overview: | Students will use the engineering design process to complete an engineering design challenge, |
| Learning Goals | |
| Standard(s): | <p>ENG.02 Use the design process to solve problems by creating and refining prototypes.</p> <p>ENG.03 Ensure quality control using the major components of manufacturing processes including measurement systems, tools and instruments to produce a product.</p> <p>EKS.05 Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).</p> <p>MAN.01 Employ engineering design process to achieve desired outcomes</p> |
| Essential Question(s): | <ul style="list-style-type: none"> ● What can be engineered? ● Why use engineering steps to solve a problem or improve upon an existing design? ● Why do engineers create simulations? ● How do engineers track performance and results? ● How can computers help predict the performance of a design? ● What is the value of STEM in creating better designs in engineering? ● What is the importance of CAD when designing? |
| Enduring Understanding(s): | <ul style="list-style-type: none"> ● There are phases in the engineering design process to check one's work and explain the steps that led to conclusions ● One must know how to use the engineering design process in order to document work in an engineering environment. ● Four main steps of the Engineering Design Process are: Input, Process, Output, Feedback |
| Learning Goal(s): <i>Students will be able to use</i> | <p>Content: (Students will know...)</p> <ul style="list-style-type: none"> ● universal Design Model (USM) vs. Engineering Design Process (EDP). |

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| <p><i>their learning to:</i> (Content/ Skills)</p> | <ul style="list-style-type: none">● what is meant by data and results.● how to translate a model into something functional. <p>Skills: (Students will be able to...)</p> <ul style="list-style-type: none">● create simulations or simple 3D models.● explain how the USM and EDP are similar and different.● improve a design using data from testing.● construct functional devices/models that solve a problem. |
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| Unit Number and Title: | Unit 3 - Mechanical System |
| Duration: | 6-8 Weeks |
| Resource(s): | Various electrical supplies, consumables, computers, fasteners. VEX Robotics Workcell Classroom kits. |
| Unit Overview: | Students will gain an understanding of simple machines and how they initiate or work with forces in the physical world. |
| Learning Goals | |
| Standard(s): | ENG.04 Design using the appropriate materials in engineering by identifying, comparing, selecting and testing. ENG.06 Use engineering equipment, laboratory materials and tools appropriately and safely. ENG.11 Demonstrate the application of science and math principles to the mechanical engineering process. |
| Essential Question(s): | <ul style="list-style-type: none"> ● What defines a “machine”? ● What are the forces and moments that act on mechanical systems? ● How do these forces and moments affect the motion and behavior of mechanical systems? ● How can we design mechanical systems to withstand the forces and moments? ● How can we use mechanical systems to transmit power and motion? |
| Enduring Understanding(s): | <ul style="list-style-type: none"> ● There are phases in the engineering design process to check one’s work and explain the steps that led to conclusions ● One must know how to use the engineering design process to document work in an engineering environment. ● Four main steps of the Engineering Design Process are: Input, Process, Output, Feedback |
| Learning Goal(s): <i>Students will be able to use their learning to:</i> | Content: (Students will know...) <ul style="list-style-type: none"> ● simple machines |

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| (Content/ Skills) | <ul style="list-style-type: none"> ● hearing. ● how forces and energy in a trebuchet system are affected by scaling. <p>Skills: (Students will be able to...)</p> <ul style="list-style-type: none"> ● demonstrate how simple machines transfer energy ● solve simple machine-related math problems ● create and troubleshoot mechanical components ● create and interpret plans, diagrams, and working drawings in the construction of a prototype mechanism. ● use various materials to build and test functional prototypes. (materials include but are not limited to: GEARS ID, VEX Robotics Design System, LEGO, 3D printed-in-lab pieces) |
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