Principles of Engineering 1: Curriculum Guide

Course Description	Principles of Engineering 1 is a hands-on application of physics and engineering concepts. This course is part of the PLTW Engineering curriculum and looks at the use of technology, math, and scientific ideas throughout the entire engineering process. In this course, students engage with a variety of engineering projects on topics related to bridges, circuits, trebuchets, simple machines, water filtration, and insulation. Students are exposed to several engineering fields such as material design, civil engineering, and mechanical engineering. The activities in class are designed to have students work in groups and use modern technology to develop solutions for engineering problems. The honors level course requires a higher level of written analysis and presentation within the curriculum.

Unit: Mechanisms	
Essential Questions	• **How do simple and compound machines form the basis of complex mechanical systems?** • **How can the engineering design process be used to solve real-world problems through the development of innovative mechanical devices?**
Skills/Standards/Topics	• Simple and Compound Machines: Exploration of basic mechanical components and their applications. • Pulley Systems and Gear Ratios: Understanding how pulleys and gears work to optimize mechanical efficiency. • Types of Motion in Mechanisms: Study of linear, rotary, reciprocating, and oscillating motion and their applications. • Engineering Design Process: Application of the engineering design process to create and improve mechanical devices. Students will be able to… • Identify and describe the function of simple and compound machines in everyday devices • Analyze the efficiency of pulley systems and design a system to maximize force output • Compare different types of gears and gear ratios to determine how they affect speed and torque • Apply their understanding of motion to design and build a mechanism that solves a specific problem

	● Collaborate with peers to integrate individual mechanisms into a large-scale device using the engineering design process
Resources	

Unit: Structures	
Essential Questions	● **How can sustainable design practices be integrated into the development of infrastructure to benefit both local and global communities?** ● **What role do material properties and structural analysis play in ensuring the safety and efficiency of static systems?**
Skills/Standards/Topics	● Static Structures and Forces: Exploration of forces acting on static systems and their impact on structural stability. ● Sustainable Infrastructure Design: Investigation of sustainable practices and life cycle analysis in infrastructure. ● Building Materials and Properties: Study of different materials used in construction and their influence on design decisions. ● 3-D Modeling and Structural Analysis: Use of 3-D modeling software to analyze structural designs and optimize them for specific engineering challenges. Students will be able to… ● Apply mathematical principles to analyze forces and moments in static structures ● Design and test a cantilever beam to evaluate structural stability under various load conditions ● Investigate and compare the properties of different building materials and their suitability for various types of structures ● Use 3-D modeling software to simulate and analyze factors affecting beam deflection and structural integrity ● Collaborate in teams to develop and present sustainable infrastructure solutions that address both local and global challenges
Resources	

Unit: Electrical Energy	
Essential Questions	● **How do different energy sources and conversion processes impact the efficiency and sustainability of systems?** ● **What are the implications of energy choices on social,**

	environmental, political, and economic systems?
Skills/Standards/Topics	• Circuits and Electrical Principles: Understanding basic electrical concepts, circuit design, and motor/generator functions. • Energy Conversion and Efficiency: Exploration of how energy is converted, where losses occur, and how to optimize efficiency. • Renewable Energy Sources: Investigation of various renewable energy sources and their broader impacts. • Sustainable Car Design: Integration of mechanical and electrical systems to design energy-efficient vehicles. Students will be able to… • Construct and analyze basic electrical circuits using breadboards, motors, and lights • Reverse engineer a motor to create a functional generator, understanding the principles of energy conversion • Research and debate the social, environmental, and economic impacts of various renewable energy sources • Apply the engineering design process to create and test a device that converts mechanical energy into electrical energy • Design and build an energy-efficient car that incorporates concepts from both mechanical mechanisms and electrical systems
Resources	

Unit: Applications of Robotics	
Essential Questions	• **How can robotics and programming be utilized to solve complex real-world problems?** • **What role do sensors and artificial intelligence play in enhancing the functionality of robotic systems?**
Skills/Standards/Topics	• Introduction to Robotics and Programming: Basic concepts of robotics, programming, and VEX robotics systems. • Sensors and Artificial Intelligence: Exploration of how sensors and AI are used in robotics to interact with and adapt to environments. • Mechanical Design and Robotics Integration: Application of mechanical design principles to create functional robotic systems. • Collaborative Problem-Solving: Use of project management, communication, and teamwork to develop robotics solutions. Students will be able to… • Utilize VEX robotics testbeds to investigate and program input and

	output devices ● Apply programming skills to design and control robotic systems using sensors and feedback loops ● Design and build a functioning pinball machine, integrating mechanical, electrical, and programming concepts from previous units ● Explore and implement artificial intelligence in robotic applications to enhance decision-making processes ● Collaborate effectively in teams to solve complex problems using robotic systems and programming
Resources	