

Northern York County School District

Curriculum Overview

Course: Engineering Design Grade Level: 9-12	
Course Description: Engineering Design is a semester-long course introducing students to the world of engineering product design. Students learn the steps of the engineering design process and then work through those steps as they complete various structural, mechanical, electrical, hydraulic, and/or pneumatic design challenges. As students generate their design solutions, a heavy emphasis is placed on the use of AutoCAD and Autodesk Inventor for developing and presenting their solutions, as well as 3-D printing technology as a means of manufacturing prototype designs.	
 Course Objectives: Students will be able to design, build and test models of various structural, mechanical, electrical, and hydraulic systems. Students will be able to understand and implement the steps of the Engineering Design Process while designing solutions to various real-world engineering challenges. Students will be able to create and test prototype designs of their original design solutions. Students will be able to understand and apply various S.T.E.M. principles (i.e., compression, tension, speed, velocity, acceleration, mass, etc.) while designing, building, and testing their solutions. Students will be able to use AutoCAD and Autodesk Inventor to create presentation drawings and models with which to communicate their design intent. 	
Related Standards:	
Pennsylvania Technology and Engineering Stando	ards (Grades 6-12)
 Nature and Characteristics of Technology & Engine Demonstrate the use of conceptual, graph modeling to identify conflicting considerationaid in design decision making. 	neering: nical, virtual, mathematical, and physical ons before the entire system is developed and to
 Integration of Knowledge, Technologies, and Prace Develop a plan that incorporates knowled disciplines to design or improve a technolo Synthesize data and analyze trends to mak systems, or processes. 	ctices: ge from science, mathematics, and other gical product or system. e decisions about technological products,

Design Thinking in Technology and Engineering Education:

- Apply a broad range of design skills to a design thinking process.
- Analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems.
- Implement the best possible solution to a design using an explicit process.
- Optimize a design by addressing desired qualities within criteria and constraints while considering trade-offs.
- Safely apply an appropriate range of making skills to a design thinking process.

Units:

- 1. The Engineering Design Process
- 2. Designing Structural Systems
- 3. Designing Mechanical Systems
- 4. Designing Electrical Systems
- 5. Designing Hydraulic and Pneumatic Systems
- 6. Prototyping and Presenting Design Solutions

Concepts:

- Engineering design process
- Criteria and constraints
- Structural systems
- Beam strength
- Joint strength
- Compression
- Tension
- Column strength
- Mechanical systems
- Mechanical advantage
- Measuring
- Accuracy and precision
- Measurement devices
- Density
- Simple machines
- Electrical systems
- Speed and velocity
- Acceleration
- Force
- Mass
- Gear ratio
- Hydraulic and pneumatic systems
- Prototyping
- CADD
- Presentation graphics
- Programming

Competencies:

- <u>Engineering Principles</u>: Measuring, Accuracy and Precision, Measurement Devices, Density, Simple Machines (Inclined Plane, Lever, Wedge, Wheel and Axle, Pulley, Screw)
- Engineering Design Process: Defining the Problem, Generating Concepts, Developing a Solution, Constructing and Testing the Solution, Evaluating the Solution, Presenting the Solution
- <u>S.T.E.M. Principles</u>: Compression, Tension, Speed, Velocity, Acceleration, Force, Mass, Trajectory, Gear Ratio, Mechanical Advantage, Maximum Load Capacity
- <u>Prototype Design, Building, and Testing</u>: Bridges, Towers, Mousetrap Vehicles, Cranes, Catapults, Trebuchets, Electric Cars, Solar-Powered Vehicles, Hydraulic Robot Arms
- <u>Engineering CAD</u>: Using AutoCAD and Autodesk Inventor to create working drawings, 3-D models, and design presentations.
- <u>3-D Printing</u>: Native CAD files (.dwg, .blend, .x_t, .sldprt, .sldasm, .ipt, .iam, .skp), Neutral CAD files (.stl, .amf, .obj, .stp, .step, .3mf, .iges)
- Career Education and Work:

	Work Habits, Cooperation and Teamwork, Group Interaction, Time Management
 Learning Activities: Teacher demonstrations Individual classwork Small/large group projects 	Performance Tasks: Balsa Bridge Balsa/Straw Tower Mousetrap Vehicle Crane Catapult Trebuchet Electric Car Ray Catcher T-Bot II

Other Assessment Measures:

- Engineering notebook
- Project-specific data sheets
- Crossword puzzles
- Word searches
- Online test/quizzes

Textbook/Primary Resource:

• Engineering Design: An Introduction (John Karsnitz, Stephen O'Brien, and John Hutchinson)

Supplemental Resource Materials:

- Pitsco Education Civil Engineering Teacher's Guide
- Pitsco Education Mechanical Engineering Teacher's Guide
- AutoCAD software
- Autodesk Inventor software
- Teacher-generated instructional resources