



Design & Modeling (PLTW)

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Deborah Knoll, (615) 532-2844, Deborah.Knoll@tn.gov
Course Code:	0783
Prerequisite(s):	None
Credit:	N/A
Grade Level:	6
Graduation Requirement:	N/A
Coursework and Sequence:	This is a course in the <i>Project Lead the Way (PLTW)</i> middle school sequence of coursework.
Necessary Equipment:	Visit www.pltw.org for more information.
Aligned Student Organization(s):	Technology Student Association (TSA): http://www.tntsa.org Tracy Whitehead, (615) 532-2804, Tracy.Whitehead@tn.gov
Coordinating Work-Based Learning:	N/A
Available Student Industry Certifications:	N/A
Dual Credit or Dual Enrollment Opportunities:	N/A
Teacher Endorsement(s):	001, 013, 014, 015, 016, 017, 018, 047, 070, 078, 081, 101, 210, 211, 212, 213, 214, 230, 231, 232, 233, 400, 401, 402, 413, 414, 415, 416, 417, 418, 440, 470, 477
Required Teacher Certifications/Training:	Teachers who have never taught this course MUST attend the training provided by PLTW and receive PLTW certification. This course has an associated fee through the vendor.
Teacher Resources:	https://tn.gov/education/article/cte-cluster-middle-school-cte-coursework

Course Description

This is a course in the series of *Project Lead the Way (PLTW)* curriculum. For more information, visit the PLTW website at <http://www.pltw.org/>.

Program of Study Application

These courses build knowledge and skills related to the following career clusters:

- 1) Architecture & Construction
- 2) Information Technology (IT)
- 3) Manufacturing
- 4) Science, Technology, Engineering & Mathematics (STEM)
- 5) Transportation, Distribution, & Logistics

Course Standards

The course standards outlined below are the copyrighted property of *Project Lead the Way*. Teachers must participate in *Project Lead the Way* training in order to be able to teach this course. This course is one in a series of PLTW middle school courses. The lesson numbers below reflect the recommended sequence.

Lesson 1.1 What is Engineering? (7 days)

Understandings

- 1) An engineering notebook is used to record original ideas or designs and to document the design process related to an invention or innovation.
- 2) A portfolio is an organized collection of best works.
- 3) Science is the study of the natural world, while technology is the study of how humans develop new products to meet needs and wants.
- 4) Teams of people can accomplish more than one individual working alone.
- 5) Technological change is seen through inventions, innovations, and the evolution of technological artifacts, processes, and systems.
- 6) Technology can have positive and negative social, cultural, economical, political, and environmental consequences.
- 7) Engineers, designers, and engineering technologists are needed in high demand for the development of future technology to meet societal needs and wants.

Knowledge and Skills

It is expected that students will:

- Utilize standard procedures to use and maintain an engineering notebook.
- Use guidelines for developing and maintaining an engineering notebook to evaluate and select pieces of one's own work for inclusion in a portfolio.
- Describe the relationship between science, technology, engineering, and math.
- Identify the differences between invention and innovation.
- Operate as an effective member of a team to complete an investigation.
- Describe engineering and explain how engineers participate in or contribute to the invention and innovation of products.
- Describe impacts that technology has had on society.

Lesson 1.2 Design Process (5 days)

Understandings

- 1) Many different design processes are used to guide people in developing solutions to problems.
- 2) The design brief is a tool for defining the problem; it is an agreement between the engineer and client.
- 3) Engineers use design briefs to explain the problem, identify solution expectations, and establish project constraints.
- 4) Design teams use brainstorming techniques to generate large numbers of ideas in a short amount of time, striving for quantity, not quality.
- 5) A decision matrix is a tool used to compare solution ideas to the criteria so that you can select the best solution.

Knowledge and Skills

It is expected that students will:

- Describe the design process and how it is used to aid in problem solving.
- Describe the elements of design.
- Recognize design criteria and constraints.
- Describe the purpose and importance of working in a team.
- Use the design process to solve a technical problem.
- Apply the elements of design to the design process.
- Explain a design brief and apply the concept when using the design process.
- Operate effectively as a member of a team to complete a design project.
- Use a decision matrix to select the best solution to a design.

Lesson 1.3 Measurement (5 days)

Understandings

- 1) In the United States, we use both Standard and Metric systems of measurement.
- 2) Being able to measure accurately is important at school and at home, at work and when pursuing hobbies.
- 3) Precision measuring tools are needed for accuracy, but tools must be used correctly to ensure accurate measurements are taken.
- 4) Quality workmanship and accurate measurements with precise instruments are necessary to successfully solve problems.

Knowledge and Skills

It is expected that students will:

- Select the appropriate value from a conversion chart to convert between standard and metric units.
- Convert between standard and metric measurements including inches, feet, yards, millimeters, centimeters, and meters.
- Demonstrate the ability to measure accurately with different devices and scales using both the standard and metric systems.
- Explain how to measure in different contexts

Lesson 1.4 Sketching and Dimensioning Techniques (6 days)

Understandings

The ability to create a rapid, accurate sketch is an important skill to communicate ideas.

- 1) Orthographic drawings of an object are used to provide information that a perspective drawing may not be able to show.
- 2) Engineers apply dimensions to drawings to communicate size information.

Knowledge and Skills

It is expected that students will:

- Summarize the reasoning for using sketching as a communication tool.
- Use visualization, spatial reasoning, and geometric shapes to sketch two and three dimensional shapes.
- Recognize thumbnail, perspective, isometric, and orthographic sketches.
- Recognize one and two point perspective drawings.
- Create thumbnail, perspective, isometric, and orthographic sketches.
- Accurately interpret one and two point perspective drawings.
- Communicate ideas for a design using various sketching methods, notes, and drafting views.
- Dimension an orthographic sketch following the guidelines of dimensioning.

Lesson 1.5 Designing For Production (22 days)

Understandings

- 1) Simple geometric shapes are combined and joined to create a representation of an object.
- 2) Engineers use computer-aided design (CAD) modeling systems to quickly generate and annotate working drawings.
- 3) Three-dimensional computer modeling uses descriptive geometry, geometric relationships, and dimensions to communicate an idea or solution to a technological problem.
- 4) As individual objects are assembled together, their degrees of freedom are systematically removed.
- 5) Engineers use a design process to create solutions to existing problems.
- 6) Teamwork requires constant communication to achieve the goal at hand.
- 7) The fabrication of a prototype is the opportunity for the designer to see the product as a three-dimensional object.

Knowledge and Skills

It is expected that students will:

- Describe the coordinate system and how geometric shapes work together to create objects.
- Create a three-dimensional (3D) model of an object.
- Apply geometric and dimension constraints to design CAD-modeled parts.
- Assemble the product using the CAD modeling program.
- Demonstrate the ability to produce various annotated working drawings of a 3D model.
- Identify the difference between a prototype, a model and a mock-up.
- Analyze what circumstances call for the use of a prototype, a model, and a mock-up.

- Describe why teams of people are used to solve problems.
- Brainstorm and sketch possible solutions to an existing design problem.
- Create a decision-making matrix.
- Use a decision making matrix to select an approach that meets or satisfies the constraints given in a design brief