

URBANDALE COMMUNITY SCHOOL DISTRICT  
CURRICULUM FRAMEWORK

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|----------------|--------------------------------|-------------|
| SUBJECT:       | Career and Technical Education |             |
| COURSE TITLE:  | Principles of Engineering      |             |
| PREREQUISITES: | Algebra or Teacher Approval    | 2 Semesters |

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**COURSE DESCRIPTION:**

This course that helps students understand the field of engineering/engineering technology. Exploring various technology systems and manufacturing processes help students learn how engineers and technicians use math, science and technology in an engineering problem solving process to benefit people. The course also includes concerns about social and political consequences of technological change. Students should have an interest in math, science, and technology. Visit [www.pltw.org](http://www.pltw.org) for further information.

**CONTENT STANDARDS AND BENCHMARKS:**

In order that our students may achieve the maximum benefit from their talents and abilities, the students of Urbandale Community School District's Principles of Engineering course should be able to ...

**Standard I: Demonstrate comprehension, computation, and applied technology skills.**

Benchmarks: Develop an understanding of the characteristics and scope of technology.

Demonstrate knowledge of number operations.

Apply algebraic skills.

Apply geometry skills.

Apply measurement skills.

Demonstrate the use of data analysis and probability.

Demonstrate problem solving skills.

Recognize and use connections among mathematical ideas.

Create and use representations to organize, record, and communicate mathematical idea.

Apply the unifying concepts and processes.

Demonstrate science as inquiry.

Understand the combination science and technology.

Apply science in both personal and social perspectives.



**Standard II: Develop communication, employability and life management skills.**

Benchmark: Read a wide range of print and nonprint.

Use spoken, written and visual language.

Develop an understanding of and be able to select and use information and communication technologies.



**URBANDALE COMMUNITY SCHOOL DISTRICT  
CURRICULUM FRAMEWORK**

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|                |                             |             |
|----------------|-----------------------------|-------------|
| SUBJECT:       | Vocational Education        |             |
| COURSE TITLE:  | Principles of Engineering   |             |
| PREREQUISITES: | Algebra or Teacher Approval | 2 Semesters |

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**CONTENT STANDARDS AND BENCHMARKS:**

In order that our students may achieve the maximum benefit from their talents and abilities, the students of Urbandale Community School District's Principles of Engineering course should be able to ...

**Standard I: Demonstrate comprehension, computation, and applied technology skills.**

**Benchmark: Develop an understanding of the characteristics and scope of technology.**

Indicators: Apply the nature and development of technological knowledge and process as functions of the setting.  
Demonstrate an understanding of inventions and innovations as the results of specific, goal-directed research.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Develop an understanding of the core concepts of technology.**

Indicators: Identify the criteria and constraints of a product or system and determine how they affect the final design and development.  
Explain that selecting resources involves trade-offs between competing values, such as availability, cost, desirability and waste.  
Explain that optimizing is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.  
Explain that new technologies create new processes.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams.



**Benchmark:** Develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

**Indicators:** Explain technological ideas are sometimes protected through the process of patenting.  
Explain the protection of a creative idea is central to the sharing of technological knowledge.

**Assessment:** Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams.

**Benchmark:** Develop an understanding of the cultural, social, economic, and political effects of technology.

**Indicators:** Explain how to make decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.  
Explain how ethical considerations are important in the development, selection, and use of technologies.  
Explain the transfer of a technology from one society to another can cause cultural, social, economic, and political changes affecting both societies to varying degrees.

**Assessment:** Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams.

**Benchmark:** Develop an understanding of the attributes of design.

**Indicators:** Use the design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype, testing and evaluating the design using specifications, refining the design, creating or making it, and communicating processes and results.  
Demonstrate that design problems are seldom presented in a clearly defined form.  
Demonstrate that a design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.  
Apply requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.



Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams.

**Benchmark: Develop an understanding of engineering design.**

Indicators: Explain how established design principles are used to evaluate existing designs, to collect data, and to guide the design process.  
Explain how engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.  
Explain how a prototype is a working model used to test a design concept by making actual observations and necessary adjustments.  
Explain the process of engineering design takes into account a number of factors.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams.

**Benchmark: Develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.**

Indicators: Explain how research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace.  
Demonstrate that technological problems must be researched before they can be solved.  
Understand that not all problems are technological, and not every problem can be solved using technology.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams.

**Benchmark: Develop the abilities to apply the design process.**

Indicators: Demonstrate how to identify the design problem to solve and decide whether or not to address it.  
Demonstrate how to identify criteria and constraints and determine how these will affect the design process.  
Demonstrate how to refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.



Demonstrate how to evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed

Demonstrate how to develop and produce a product or system using a design process.

Demonstrate how to evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams.

**Benchmark: Develop the abilities to use and maintain technological products and systems.**

Indicators: Demonstrate how to document processes and procedures and communicate them to different audiences using appropriate oral and written techniques.

Demonstrate how to use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams.

**Benchmark: Develop an understanding of and be able to select and use information and communication technologies.**

Indicators: Demonstrate how technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Demonstrate knowledge of number operations.**



Indicators: Demonstrate understanding of numbers, ways of representing numbers, relationships among numbers, and number systems.  
Use the meaning of operations and how they relate to one another.  
Compute fluently and make reasonable estimates.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Apply algebraic skills.**

Indicators: Demonstrate understanding of patterns, relations, and functions.  
Represent and analyze mathematical situations and structures using algebraic symbols.  
Use mathematical models to represent and understand quantitative relationships.  
Analyze change in various contexts.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Apply geometry skills.**

Indicators: Analyze characteristics and properties of two – and three-dimensional geometric shapes and develop mathematical argument about geometric relationships.  
Specify locations and describe spatial relationships using coordinate geometry and other representational systems.  
Apply transformations and sue symmetry to analyze mathematical situations.  
Use visualization, spatial reasoning, and geometric modeling to solve problems.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Apply measurement skills.**

Indicators: Apply the units, systems, and processes of measurement.  
Apply appropriate techniques, tools, and formulas to determine measurement.



Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Demonstrate the use of data analysis and probability.**

Indicators: Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.  
Select and use appropriate statistical methods to analyze data.  
Develop and evaluate inferences and predictions that are based on data.  
Understand and apply basic concepts of probability.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Demonstrate problem solving skills.**

Indicators: Build new mathematical knowledge through problem solving.  
Solve problems that arise in mathematics and in other contexts.  
Apply and adapt a variety of appropriate strategies to solve problems.  
Monitor and reflect on the process of mathematical problem solving.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Recognize reasoning and proof as fundamental aspects of mathematics.**

Indicators: Make and investigate mathematical conjectures.  
Develop and evaluate mathematical arguments and proofs.  
Select and use various types of reasoning and methods of proof.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Organize and consolidate their mathematical thinking through communications.**

Indicators: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.  
Analyze and evaluate the mathematical thinking and strategies of others.  
Use the language of mathematics to express mathematical ideas precisely.



Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Recognize and use connections among mathematical ideas.**

Indicators: Recognize and apply mathematics in contexts outside of mathematics. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Create and use representations to organize, record, and communicate mathematical idea.**

Indicators: Select, apply, and translate among mathematical representation to solve problems.  
Use representations to model and interpret physical, social, and mathematical phenomena.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Apply the unifying concepts and processes.**

Indicators: Demonstrate knowledge of systems, order, and organization.  
Demonstrate knowledge of evidence, models, and explanation.  
Demonstrate knowledge of change, constancy, and measurement.  
Demonstrate knowledge of evolution and equilibrium.  
Demonstrate knowledge of form and function.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark: Demonstrate science as inquiry.**

Indicators: Demonstrate abilities necessary to do scientific inquiry.  
Apply understandings about scientific inquiry.

Assessment: Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams



**Benchmark:** Understand the combination science and technology.

**Indicator:** Apply the abilities of technological design.

**Assessment:** Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark:** Apply science in both personal and social perspectives.

**Indicators:** Develop understanding of natural resources.

Develop understanding of science and technology in local, national, and global challenges.

**Assessment:** Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Standard II: Develop communication, employability and life management skills.**

**Benchmark:** Apply a variety of strategies to comprehend, interpret, evaluate, and appreciate texts.

**Indicators:** Draw on prior experiences to comprehend, interpret, and evaluate texts

Interact with other readers and writers to comprehend, interpret, and evaluate texts.

Apply understanding of text features to comprehend, interpret, and evaluate texts.

Apply knowledge of word identification, word meaning and other texts to comprehend, interpret, and evaluate texts.

**Assessment:** Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

**Benchmark:** Use spoken, written and visual language.

**Indicators:** Use spoken, written and visual language for learning, enjoyment, persuasion, and the exchange of information.

Communicate mathematical thinking.

**Assessment:** Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams



**Benchmark:** Develop an understanding of and be able to select and use information and communication technologies.

**Indicator:** Demonstrate how processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

**Assessment:** Projects with specific rubrics, projects with checklists, teacher generated tests, projects with short answer, PLTW exams

