

IT6 Engineering Design and 3D Manufacturing

ITEEA Standards:

Standard 1: Students will develop an understanding of the characteristics and scope of technology. Students in the middle-level grades will explore in greater detail the scope of technology. From personal and classroom experience, students will be familiar with specific ways in which technology is dynamic, and teachers should build on this experience by reinforcing the idea that technology is constantly changing.

- **F. New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.**
- **G. The development of technology is a human activity and is the result of individual or collective needs and the ability to be creative.**
- **H. Technology is closely linked to creativity, which has resulted in innovation.**
- **I. Corporations can often create demand for a product by bringing it onto the market and advertising it.**

Standard 2: Students will develop an understanding of

the core concepts of technology. Technology has a number of core concepts that characterize it and set it apart from other fields of study. These concepts serve as cornerstones for the study of technology.

- **N. Systems thinking involves considering how every part relates to others.**
- **P. Technological systems can be connected to one another.**
- **Q. Malfunctions of any part of a system may affect the function and quality of the system.**
- **R. Requirements are the parameters placed on the development of a product or system.**
- **T. Different technologies involve different sets of processes.**

Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

The products of technology are used in every field of study. Technological progress often sparks advances and sometimes can even create a whole new field of study.

- **D. Technological systems often interact with one another.**
- **F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems.**

Standard 5: Students will develop an understanding of the effects of technology on the environment.

The impact of the use of technology on the environment can be positive or negative. As the use of technology has grown, so too, has its potential to affect the environment — a hundred million cars have an effect that a hundred do not. It is therefore essential that all decisions about the use of technology be made with the environment in mind.

- **D. The management of waste produced by technological systems is an important societal issue.**
- **F. Decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another.**

Standard 6: Students will develop an understanding of the role of society in the development and use of technology. Just as technology molds society, so too does society mold technology, shaping it in big ways and small.

- **E. The use of inventions and innovations has led to changes in society and the creation of new needs and wants.**
- **G. Meeting societal expectations is the driving force behind the acceptance and use of products and systems.**

Standard 8: Students will develop an understanding of the attributes of design.

Design is the first step in the making of a product or system. Without design, the product or system cannot be made effectively.

- **E. Design is a creative planning process that leads to useful products and systems.**
- **F. There is no perfect design.**
- **G. Requirements for a design are made up of criteria and constraints.**

Standard 9: Students will develop an understanding of engineering design. The design process is fundamental to technology and to engineering. Also referred to as technological design, the engineering design process demands critical thinking, the application of technical knowledge, creativity, and an appreciation of the effects of a design on society and the environment.

- **F. Design involves a set of steps, which can be performed in different sequences and repeated as needed.**
- **G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum.**
- **H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.**

Standard 11: Students will develop abilities to apply the design process. Almost any technology that a student encounters is the result of a systematic problem-solving design process that transformed an idea into a final product or system. This design process involves an in-depth understanding of the problem and resources available, an exhaustive search for solutions, and an extensive evaluation and refinement procedure.

- **H. Apply a design process to solve problems in and beyond the laboratory-classroom.**
- **I. Specify criteria and constraints for the design.**
- **K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.**

ISTE Standards: The ISTE Standards provide the competencies for learning, teaching and leading in the digital age, providing a comprehensive roadmap for the effective use of technology.

1.4 Innovative Designer: Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.

- **1.4a:** Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.

1.5 Computational Thinker: Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

- **1.5c:** Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

1.7 Global Collaborator: Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally.

- **1.7b:** Students use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.

CTE Frameworks: This class addresses the Business and Technology, Trades & Industry content areas.

A. Benchmarking against Standards: Students will create products within given criteria and tolerance level.

B. Assessing student achievement through demonstrated performance: Students will be graded based on the quality of product produced, as well as their ability to demonstrate competency of the manufacturing process.

CSTA Standards: Students will learn about computer components, and be able to build their own. Students will also learn about cyber ethics, cyber law and digital responsibility. Students will also conduct research into computer science careers to learn more about computer science opportunities in the workplace.

- **1B-CS-01:** Recommend improvements to the design of computing devices, based on an analysis of how users interact with the devices.
- **2-CS-03:** Systematically identify and fix problems with computing devices and their components.
- **2-NI-05** Explain how physical and digital security measures protect electronic information.
- **2-AP-14** Create procedures with parameters to organize code and make it easier to reuse.
- **2-AP-15** Seek and incorporate feedback from team members and users to refine a solution that meets user needs.

NGSS Standards: By the time students reach middle school they should have had numerous experiences in engineering design. The goal for middle school students is to define problems more precisely, to conduct a more thorough process of choosing the best solution, and to optimize the final design.

ETS1.A: Defining and Delimiting Engineering Problems

- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

ETS1.B: Developing Possible Solutions

- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.(MS-ETS1-3)
- Models of all kinds are important for testing solutions. (MS-ETS1-4)

Outline for Class

Week 1-2 Intro to Google Classroom, Measurement and Design Process

- Use a variety of technology to complete tasks and turn them into the google classroom
- Measuring using a Ruler/Tape Measure
- Introduction to the Design Process

Week 3-8 3D Design and Printing using TinkerCAD

- Review of TinkerCAD and tools, creating a design
- Using technology to create a free sketch design
- Orthographic views representing 3D shapes
- 3D Initial Design
- Teacher Appreciation Project

Week 9-12 Glowforge Manufacturing

- Using InkScape for Glowforge applications
- Creating Text and Images in InkScape
- Creating a Glowforge design
- Manufacturing a Scaled Model of your Room

Week 12-16 Introduction to OnShape CAD

- Jumping into OnShape and its tools
- Why do we use CAD?
- Creating 3D models and designs in OnShape
- Modifying and Revising Models

Week 17-18 - Aerodynamics and Flight

- Creating a Wind Powered Car
- Paper Airplane design and testing

Engineering Design and Manufacturing In this course students will be introduced to a variety of new CAD software in order to produce a variety of designs and models. Students will use both technology and concrete materials to produce high quality products as dictated by specific criteria and constraints.