Course: Engineering Design **Unit #3: Fabrication and Design**	**Year of Implementation:** 2019-2020

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Stage One - Desired Results

Link(s) to New Jersey Student Learning Standards for this course:

https://www.state.nj.us/education/cccs/2014/career/CareerReadyPractices.pdf

https://www.state.nj.us/education/aps/cccs/career/

Unit Standards:

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.

B. Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.

C. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others

D. Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.

F: Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources

8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

A. The Nature of Technology: Creativity and Innovation Technology systems impact every aspect of the world in which we live
B. Technology and Society: Knowledge and understanding of human, cultural and societal values are fundamental when designing technological systems and products in the global society.

C. Design: The design process is a systematic approach to solving problems.
D. Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.

9.3 Career and Technical Education:
9.3.12.AC.6 Read, interpret and use technical drawings, documents and specifications to plan a project.
9.3.12.AC-DES.6 Apply the techniques and skills of modern drafting, design, engineering and construction to projects.
9.3.12.AC-DES.1 Justify design solutions through the use of research documentation and analysis of data.
9.3.12.AC-DES.2 Use effective communication skills and strategies (listening, speaking, reading, writing and graphic communications) to work with clients and colleagues
9.3.ST-ET.1 Use STEM concepts and processes to solve problems involving design and/or production.
9.3.ST-ET.2 Display and communicate STEM information.
9.3.ST-ET.3 Apply processes and concepts for the use of technological tools in STEM.
9.3.ST-ET.4 Apply the elements of the design process.
9.3.12.AC-CST.7 Compare and contrast the building systems and components required for a construction project.
9.3.12.AC-CST.8 Demonstrate the construction crafts required for each phase of a construction project.
9.3.12.AC-CST.9 Safely use and maintain appropriate tools, machinery, equipment and resources to accomplish construction project goals.

Transfer Goal(s): Students will be able to independently use their learning to fabricate a product according to varied design specifications.

Enduring Understandings Students will understand that. . .	*Essential Questions*
EU 1 accuracy and attention to detail while using tools leads to efficient fabrication.	*EU 1* ● What does it mean to use tools efficiently? ● How can inaccurate measuring affect a project? ● How is attention to detail related to accuracy?

EU 2 selecting the right tools and materials are necessary to be a successful engineer. *EU 3* innovation is as important as invention.	*EU 2* ● What are the effects of tool and material selection? ● How can availability of tools and materials affect product design? *EU 3* ● What can you learn from someone else's design? ● How are analysis and innovation related? ● Why should we constantly evaluate the product?
<u>Knowledge</u> *Students will know . . .* *EU 1* ● safety rules for fabrication tools. ● the meaning of the expression "measure twice, cut once". *EU 2* ● properties and limitations of available tools and materials. *EU 3* ● what the difference is between invention and innovation. ● how to accurately evaluate an innovation or invention.	*<u>Skills</u>* Students will be able to. . . *EU 1* ● use fabrication tools safely. ● measure materials accurately so that they are used as efficiently and economically as possible. ● fabricate project components from 2D and 3D CAD designs and models. ● problem-solve fabrication issues. *EU 2* ● select appropriate materials. ● design products according to the tools available. *EU 3* ● research different models/generations of an existing product and evaluate the success of newer innovations.

	● evaluate an innovation and propose additional innovations.

Stage Two - Assessment

Other Evidence:

- Self-assessment by student of their learning activities
- Completion of projects and prototypes
- Observation of the student during the learning activities.
- Completion of project documentation.
- Completion of project journals.
- Application of design process to given projects

Stage Three - Instruction

Learning Plan: **Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: Each learning activity listed must be accompanied by a learning goal of A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.**

- Use the internet to research engineering characteristics of existing examples of a designated project. (**A, EU3)**
- Discuss and demonstrate safe handling and procedures for using fabrication tools. (**A, EU1)**
- Measure objects using a caliper. (**A, M, EU1)**
- Create an Assembly Drawing of an object. **(A, T, EU1, EU2, EU3)**
- Discuss the applications of reverse engineering and its effect on society. (**M, T, EU3)**
- Reverse engineer a simple machine. (**M,T EU3)**
- Fabricate and create a roller coaster out of a box of 'random' materials. (**M,T, EU1, EU2)**

- Fabricate and create a cardboard chair. (**M,T, EU1, EU2)**
- Fabricate and create a pinball machine. (**M, T, EU1, EU2, EU3)**
- Fabricate and create a miniature golf course. (**M, T, EU1, EU2, EU3)**
- Fabricate and create a 3D printed action figure. (**M, T, EU1, EU2, EU3)**
- Fabricate and create a morse code switch to send messages.(**M, T, EU1, EU2, EU3)**
- Fabricate and create a recycled flashlight. (**M, T, EU1, EU2, EU3)**
- Fabricate and create a 3D printed monster truck. (**M, T, EU1, EU2, EU3)**