SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW

Course Title: Design and Fabrication II	**Length of Course:** Full Year
Grade Level(s): 11-12	**Periods Per Cycle:** 6
Units of Credit: 1	**Length of Period:** 40 Minutes
Classification: Elective	**Total Instructional Time:** 120 Hours

Course Description

This is the second class of two at the high school that is intended for students to utilize the Design Process for authentic learning experiences. Students will begin with design a concept through computer aided drafting, analyzing the effectiveness of the design by using prototyping and then engineer the design within the metal or wood shop setting. Students will be expected to demonstrate application of STEM curricula and work through the design process with minimal assistance from the teacher. Students will be working towards demonstrating mastery of the design and fabrication process in preparation for the STEM Capstone course.

Instructional Strategies, Learning Practices, Activities, and Experiences

Build Upon and Develop Minimum Competency Skills (MICS) Develop Advanced Competency Skills Design and Self-Reflect for Action Steps	Independent Research Project Construction Posted Objectives and Agendas	Bell Ringers Design, Build, Practice, Assess Process Journal Logs Constructive Responses

Assessments

Journals Weekly Checkpoints Small Group Discussions	Independent Projects Group Projects Panels of Experts	Competition Judges Competition Results Interviews with Local Businesses and Organizations

Materials/Resources

Technology Procedures and Equipment Instructor Provided Rubrics	Daily, Weekly, and Monthly Student Created Objectives	Competition Guidelines Various Materials Determined by Student(s') Needs

Adopted: 8/18/08
Revised: 5/21/18, 12/9/20, 5/22/23

Woodworking Unit	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Design Process Woodworking CAD/CAM Software	**Objective** SWBAT to identify a need and working as an individual or team design and fabricate a woodworking project for the identified need. **Next Generation Science Standards (NGSS):** HS-ETS1-1 - Analyze a major global or District challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. **Minimum Competency Skills:** **Computer Aided Design:** The student will have the ability to create sketches in given 3D design software. The student will have the ability to create part files in given 3D design software. The student will have the ability to take part files and assemble them into a digital model in given 3D design software . The student will have the ability to made blueprints of a designed item in given 3D design software. The student will have the ability to make modifications to a designed model in given 3D design software. The student will have the ability to use a computer model of project to test for test for fit & interference in given 3D design software. The student will have the ability to use a computer model of project to create a scale model in given 3D design software . The student will have the ability to explain design choices of a student designed project modeled in given 3D design software. **Wood:** The student will have the ability to safely operate a table saw following course regulations. The student will have the ability to safely operate a planer following course regulations.

Woodworking Unit (Continued)	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
	The student will have the ability to safely operate a jointer following course regulations. The student will have the ability to safely operate a miter saw following course regulations. The student will have the ability to safely operate a drill press following course regulations. The student will have the ability to safely operate a cordless drill/driver following course regulations. The student will have the ability to safely operate a router (both palm and table-top) following course regulations. The student will have the ability to safely operate a palm sander following course regulations. The student will have the ability to make proper adjustments to a table saw as needed for a cut. The student will have the ability to make proper adjustments to a planer as needed for a cut. The student will have the ability to make proper adjustments to a miter saw as needed for a cut. The student will have the ability to measure and cut materials accurate to within 1/16 of an inch. The student will have the ability to mill a piece of rough-cut lumber to flat, square, and surfaced on 4 sides. The student will have the ability to select the proper machine to use for a given cut or operation. The student will have the ability to describe 3 concerns that exist with seasonal wood movement. The student will have the ability to edge glue 2 or more pieces using wood glue and clamps to create a panel. The student will have the ability to identify a minimum of 4 different wood joints. The student will have the ability to select the proper type of wood joint to use for a given application. The student will have the ability to join 2 pieces of lumber using pocket hole joints. The student will have the ability to join 2 pieces of lumber using miter joints. The student will have the ability to join 2 pieces of lumber using butt joints (nails, screws, or dowels). The student will have the ability to join 2 pieces of lumber using rabbet joints. The student will have the ability to use a jig and/or clamp to aid in workpiece placement for furniture assembly. The student will have the ability to prepare a surface for finish by progressively sanding down to 220-grit (or higher as needed). The student will have the ability to apply a finish to a workpiece (stain, oil, wax, polyurethane, etc.). The student will have the ability to calculate board-feet of lumber. The student will have the ability to accurately check a piece of furniture for square and level.

Metal Unit	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Design Process Hot Metalworking Cold Metalworking CAD/CAM Software	**Objective** SWBAT to identify a need and working as an individual or team design and fabricate a metalworking project for the identified need. **Next Generation Science Standards (NGSS):** HS-ETS1-1 - Analyze a major global or District challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. **Minimum Competency Skills:** **Computer Aided Design:** The student will have the ability to create sketches in given 3D design software. The student will have the ability to create part files in given 3D design software. The student will have the ability to take part files and assemble them into a digital model in given 3D design software . The student will have the ability to made blueprints of a designed item in given 3D design software. The student will have the ability to make modifications to a designed model in given 3D design software. The student will have the ability to use a computer model of project to test for test for fit & interference in given 3D design software. The student will have the ability to use a computer model of project to create a scale model in given 3D design software . The student will have the ability to explain design choices of a student designed project modeled in given 3D design software. **Metals:** Students will identify hand tools used to work with metals, and safely use specified tool. Students will identify various gauges of sheet metal.

Metal Unit (Continued)	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
	Students will identify and safely use various sheet metal shaping machines. Students will identify gases used for welding. Students will identify and use required PPE for welding. Students will set the welder for various types of metals regarding wire feed and voltage. Students will weld metals at 45- or 90-degree angles. Students will weld metals using all three processes. Students will Identify PPE when forging hot metals. Students will identify and safely use hand tools when forging. Students will identify metals that can be forged. Students will explain the steps used to forge and finish metals. Students will know the temperature to properly forge. Students will explain what quenching is and why the process is important.

Architectural Design Unit	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Architectural Design Design Process CAD/CAM Software Woodworking Metalworking Structural Testing and Assembly Finishing Work	**Objective:** SWBAT demonstrate us of software to design a functional, aesthetically pleasing, and sustainable structure that meets the needs of the project constraints. **Next Generation Science Standards (NGSS):** HS-ETS1-1 - Analyze a major global or District challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. **Minimum Competency Skills:** **Computer Aided Design:** The student will have the ability to create sketches in given 3D design software. The student will have the ability to create part files in given 3D design software. The student will have the ability to made blueprints of a designed item in given 3D design software. The student will have the ability to make modifications to a designed model in given 3D design software. The student will have the ability to use a computer model of project to test for test for fit & interference in given 3D design software. The student will have the ability to use a computer model of project to create a scale model in given 3D design software . The student will have the ability to explain design choices of a student designed project modeled in given 3D design software.

CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) Unit	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Computer Aided Design/Computer Aided Manufacturing Mechanical Structures (Robotics)	**Objective:** SWBAT use the Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) process to design and fabricate a mechanical device which meets the minimal project constraints. **Next Generation Science Standards (NGSS):** HS-ETS1-1 - Analyze a major global or District challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. **Minimum Competency Skills:** **Computer Aided Design:** The student will have the ability to create sketches in given 3D design software. The student will have the ability to create part files in given 3D design software. The student will have the ability to take part files and assemble them into a digital model in given 3D design software. The student will have the ability to made blueprints of a designed item in given 3D design software. The student will have the ability to make modifications to a designed model in given 3D design software. The student will have the ability to use a computer model of project to test for test for fit & interference in given 3D design software. The student will have the ability to use a computer model of project to create a scale model in given 3D design software. The student will have the ability to explain design choices of a student designed project modeled in given 3D design software. The student will have the ability to explain how the CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) process was used to make a student designed artifact. The student will have the ability to prepare files in design software for Computer Aided Manufacturing in given 3D design software.

CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) Unit (Continued)

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
	The student will have the ability to use post processing software to prepare files for Computer Aided Manufacturing. The student will have the ability to prepare and operate machines for the CAD/CAM process. The student will have the ability to prepare materials for CAD/CAM. The student will have the ability to assemble parts made by CAD/CAM.