



SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW



Course Title: Design and Fabrication I Grade Level(s): 10-12 Units of Credit: 1 Classification: Elective	Length of Course: Full Year Periods Per Cycle: 6 Length of Period: 40 Minutes Total Instructional Time: 120 Hours
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Course Description

This is the first 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. Projects will be determined by student interest.

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
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Assessments

Journals Weekly Checkpoints	Independent Projects Group Projects	Small Group Discussions Project Completion
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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
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Adopted: 8/18/08

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

Unit 1 Safety and Introduction to Labs	
CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
<p>Lab Safety CAD Basics 3D Printing</p>	<p>Objective: SWBAT demonstrate an understanding of how to utilize Computer Aided Design software within the CAD lab. SWBAT demonstrate an understanding of how to utilize the machinery and tools within the metal and wood shop areas. SWBAT explore careers in the fields of Design and Fabrication and gain an understanding of desired employment and/or higher education requirements.</p> <p>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.</p>

Unit 2 Geometric Shapes	
CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
<p>CAD/CAM Software Woodworking Metalworking</p>	<p>Objective: SWBAT to design a simple geometric shape on the CAD software. SWBAT fabricate their design within the metal and wood shop areas. SWBAT explore careers in the fields of Design and Fabrication and gain an understanding of desired employment and/or higher education requirements.</p> <p>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.</p> <p>Minimum Competency Skills: 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. 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 palm sander following course regulations. 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 join 2 pieces of lumber using rabbit joints. The student will have the ability to prepare a surface for finish by progressively sanding down to 220-grit (or higher as needed).</p>

Unit 2 Geometric Shapes (Continued)	
CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
	<p>The student will have the ability to apply a finish to a workpiece (stain, oil, wax, polyurethane, etc.).</p> <p>The student will have the ability to calculate board-feet of lumber.</p> <p>The student will have the ability to accurately check a piece of furniture for square and level.</p> <p>Metal:</p> <p>The student will have the ability to use a measuring tool to measure to a tolerance of +- 1/16".</p> <p>The student will have the ability to identify hand tools used to work with metals, and safely use specified tool.</p> <p>The student will have the ability to identify various gauges of sheet metal.</p> <p>The student will have the ability to identify and safely use various sheet metal shaping machines.</p> <p>The student will have the ability to safely fuse sheet metal together with a spot welder.</p> <p>Computer Aided Design:</p> <p>The student will have the ability to create sketches in given 3D design software.</p> <p>The student will have the ability to create part files in given 3D design software.</p> <p>The student will have the ability to take part files and assemble them into a digital model in given 3D design software</p> <p>The student will have the ability to make modifications to a designed model in given 3D design software.</p> <p>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.</p> <p>The student will have the ability to use a computer model of project to create a scale model in given 3D design software.</p> <p>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.</p> <p>The student will have the ability to prepare files in design software for Computer Aided Manufacturing in given 3D design software.</p> <p>The student will have the ability to use post processing software to prepare files for Computer Aided Manufacturing.</p> <p>The student will have the ability to prepare and operate machines for the CAD/CAM process.</p> <p>The student will have the ability to prepare materials for CAD/CAM.</p> <p>The student will have the ability to assemble parts made by CAD/CAM.</p>

Unit 3 Forming and Molding	
CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
<p>Molding Techniques</p>	<p>Objective: SWBAT design a mold using the CAD software. SWBAT fabricate their design mold in the metal and wood shop areas. SWBAT explore careers in the fields of Design and Fabrication and gain an understanding of desired employment and/or higher education requirements.</p> <p>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.</p>

Unit 4 Assembling and Structural Testing	
CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
<p>Welding Wood Joints</p>	<p>Objective: In the metal lab, students will use structural testing to determine the strength of welded joints. In the wood lab students will use structural testing to determine the strength of various wood joints. In the CAD lab, students will compare the similarities and differences of virtual and real stress testing. SWBAT explore careers in the fields of Design and Fabrication and gain an understanding of desired employment and/or higher education requirements.</p> <p>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.</p>

Unit 5 Machining	
CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
<p>Mill Lathe (Wood and Metal)</p>	<p>Objective: SWBAT demonstrate additive manufacturing. SWBAT to demonstrate proper machining techniques of their CAD design within the metal and wood shop areas. SWBAT explore careers in the fields of Design and Fabrication and gain an understanding of desired employment and/or higher education requirements.</p> <p>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.</p>

Unit 6 Finishing	
CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
<p>Sanding/Polishing Staining Painting/Finishing</p>	<p>Objective: SWBAT demonstrate appropriate finishing techniques in all aspects of design and fabrication. SWBAT explore careers in the fields of Design and Fabrication and gain an understanding of desired employment and/or higher education requirements.</p> <p>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.</p>

Unit 7 Architectural Design and Fabrication	
CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
<p>Design Process CAD/CAM Software Metalworking Woodworking</p>	<p>Objective: SWBAT demonstrate application of the Design Process. SWBAT explore careers in the fields of Design and Fabrication and gain an understanding of desired employment and/or higher education requirements.</p> <p>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.</p>

PLANNED COURSE: STEM Capstone LEVEL: 12th Grade