Course Title	Metals 1
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Course Overview	Metals I is an elective course in the Technology Education department open to grades 9-12. This activity-based course promotes learning through doing. The course offers students hands-on opportunities to explore how metal is formed, shaped, and finished. Student activities will be concentrated in the areas of sheet metal fabrication, hot metal casting and plumbing. The purpose of Metals I is to introduce students to the process of manufacturing with metals and to spur an interest that could lead to a vocation after graduation.
Length of Course	 ☐ Full year ✓ Semester
Type of Course	 Humanities Required Credit STEM Required Credit Humanities Elective Credit STEM Elective Credit PE/Health Required Credit Other
Grade Level	 ✓ 9 ✓ 10 ✓ 11 ✓ 12
Prerequisites	None
Ledyard High School Vision of the Graduate	 Ledyard High School is a learning community dedicated to the cultivation of skills essential for our students' success in a rapidly-evolving society. At Ledyard High School, we believe our graduates should demonstrate the following: Collaboration - Colonel Graduates will demonstrate an ability to work effectively with others, sharing ideas, acknowledging one another's strengths, and collaborating to produce presentations, projects, performances, or events. Communication - Colonel Graduates will demonstrate an ability to communicate information clearly and effectively through a variety of media, including written, oral, visual, musical, and/or video productions. Problem-Solving- Colonel Graduates will demonstrate an ability to solve problems of varying complexity across a variety of content areas. Critical Thinking - Colonel Graduates will demonstrate critical thinking skills to find solutions, support arguments, and overcome challenges in a variety of content areas. Perseverance - Colonel Graduates will demonstrate perseverance in academic and extracurricular settings by working through and past obstacles in pursuit of goals.

	Creativity - Colonel Graduates will demonstrate creativity through their participation in fine arts courses as well as through their inventive approaches to learning activities in a variety of settings.
VOG Portfolio Component	Aluminum Casting Collaboration

	Unit 1: Safety Pacing: Week 1
Description	In this unit, students will demonstrate an understanding of workplace safety.
Essential Questions	1. What is the role of safety in the workplace?
	2. How are personal safety practices pertaining to eye wear, footwear, clothing, and personal protective equipment (PPE) applied in the workplace?
	3. What are the proper procedures for safe handling and operation of workplace tools, equipment, and materials?
	CT SDE Career and Technical Performance Standards*
	Learning Objectives: The student will be able to
	A. Safety: Describe and demonstrate the procedures related to workplace and job-site safety, including personal protective equipment, machine safety, and material handling practices. At the beginning of the course, Students participate in three class safety lessons where shop safety rules are read and gone over. In addition, OSHA, NIOSH and the role of MSDS sheets are gone over.
Standards/	1. Demonstrate knowledge of proper use, storage, and disposal of hazardous materials following OSHA's proper safety practices for a metal working facility.
Learning	2. Demonstrate and explain knowledge of workplace safety procedures.
Objectives	3. Demonstrate and explain knowledge of personal safety practices pertaining to eye wear, footwear, clothing, and personal protective equipment (PPE) used in material technology.
	4. Describe safety practices for basic metal working tools and machines.
	5. Demonstrate and explain knowledge of proper use and storage of basic hand tools.
	6. Demonstrate and explain knowledge of proper use and storage of portable power tools.
	7. Explain safe proper use, disposal, and storage of chemicals following OSHA standards.
	*Adapted from CT Engineering and Wood Technology Performance Standards
Application of Learning Objectives	In every unit, it is critical to apply the safety knowledge gained in this unit. It is not sufficient to just understand the safety principles. It is imperative to apply those principles throughout the course.
	Students will demonstrate safe behavior through the manufacture and production of relevant products in an authentic workplace setting. A Metals Shop Safety Guide is provided to the students along with the expectation that a safety "contract" is reviewed and signed by both the student and parent/guardian. Links:
	Metals Safety Study Guide:
	<u>Safety Study Guide</u>
	Metals Safety Contract:
	Salety Contract

Vocabulary	OSHA, NIOSH, MSDS, pinch point, safety guard, personal protective equipment, fire triangle, ABC fire extinguishers, fire blanket, safety margins
Resources	Materials for this unit are available in the Metals 1 Curriculum Resources shared Google Drive.
Assessments	Students will demonstrate knowledge of workplace safety through a written assessment and demonstrate safe behavior in the shop. The assessment is in the Metals 1 Google Drive.
	Metals Safety Test:
	<u>Safety Test</u>

	Unit 2: Planning and Layout Pacing: Week 2
Description	In this unit, students will demonstrate an understanding of planning & layout and the impact it has on waste (or scrap) material generated and costs.
Fecontial	1. What are three-view drawings and how are they read/interpreted?
Questions	2. What is a bill of materials?
	CT SDE Technology Education Standards
	Learning Objectives: The student will be able to
	MAN.03: Demonstrate the methods involved in turning raw materials into usable products
	MAN .03.02 Demonstrate the safe and accurate secondary process to create a finished product; forming; separating; combining; assembly; finishing
	CT SDE Career and Technical Education Performance Standards*
Standards/ Learning	C. Design, Measurement, and Layout: Interpret technical drawings, rough drawings and sketches, and the use fractional measurement.*
Objectives	13. Describe and identify fractional measurements from a basic plan and assembly drawings.
	14. Describe and prepare rough drawings and sketches.
	15. Explain and prepare a cut list or bill of material from a basic plan and assembly drawing.
	16. Measure accurately to a sixteenth of an inch.
	18. Estimate material quantities in linear inches and square inches.
	19. Consider the properties of gauge and zinc galvanization when laying out a board.
	*Adapted from CT Engineering and Wood Technology Performance Standards
Application of Learning Objectives	Project planning is an imperative first step towards creating a successful product. Taking the time to understand and interpret the drawings associated with a project is important. Minimizing waste and appreciating the value of scrap material.
	Students receive a drawing of the desired end product and interpret the drawing to produce a model of the product and/or create a bill of material.
Vocabulary	front view, top view, side view, isometric , units of measure, gauge , measuring, accuracy , precision , tolerance , layout, defects, dimension line, extension lines, center line, combination square, machinist ruler, layout dye, scribing, scratch awl
Resources	Materials for this unit are available in the Metals 1 Curriculum Resources shared Google Drive.
	Students will demonstrate their ability to measure accurately to within 1/16th of an inch.
Assassments	Students will properly lay out and label the views of a technical drawing.
	Students will calculate the cost of a product, or make a model of a product using information from a technical drawing.

	Pacing: Unit 3: Cutting and Preparation 3-5
Description	In this unit, students will demonstrate an understanding of cutting & preparation for metal folding. Proper sequencing of the steps is important.
	1. Why is it important to plan a layout before cutting materials?
Essential Questions	2. Which tools are appropriate for specific material processing tasks and how do we use them properly?
	CT SDE Career and Technical Performance Standards*
	Learning Objectives: The student will be able to
Standards/	E. Material Processing: Identify and describe the various types of processes associated with the metalworking field and the characteristics of metal as a medium.
Learning Objectives	23. Identify and select the proper cutting process based on material properties and dimensions.
	24. Identify how sheet metal gauge affects a material's strength.
	25. Understanding shearing and its application to cutting and layout operations.
	*Adapted from CT Engineering and Wood Technology Performance Standards
Application of Learning Objectives	It is important to follow a specific material processing sequence for optimum productivity and safety.
	Students will optimize yield from selected stock materials, using hand and machine tools in the production of relevant products.
Vocabulary	shearing, notcher, aviation snips, squaring shear, tinner's punch
Resources	Materials for this unit are available in the Metals 1 Curriculum Resources shared Google Drive.
Assessments	Students will demonstrate the ability to safely use hand and power tools to prepare materials for fabrication into various products.

	Unit 4: Joining	Pacing: Weeks 6-7
Description	In this unit, students will demonstrate an understanding of metal folding and joining techniques. Proper sequencing of the steps is important.	
Essential Questions	1. What are two metal folding methods and what is the importance of proper sequ of folds?	encing
	2. Which joining method is appropriate for a particular assembly?	
	3. How are joining methods applied for the desired result?	
	CT SDE Technology Education Standards	
	Learning Objectives: The student will be able to	
	MAN.03: Demonstrate the methods involved in turning raw materials into usable products	
Standards/	MAN.03.03 Apply a variety of manufacturing techniques and processes to create a usabl product	le
Objectives	CT SDE Career and Technical Performance Standards*	
	G. Joinery: Identify various types of joints and describe the process for preparatio assembly.	on and
	H. Assembly: Identify and describe the purpose of various types of fasteners, adh and clamping devices.	esives,
	*Adapted from CT Engineering and Wood Technology Performance Standards	
	It is important to choose the proper method and technique for proper folding/bending a joining of materials (sheet metal).	and
	Sheet metal can be joined together via several methods.	
Application of Learning	These lessons demonstrate to students the techniques of folding/bending, spot welding soldering of sheet metal. Students will use demonstrated techniques to further their artifact/project towards completion.	and
Objectives	1. Use of Bar-fold to create safety hems	
	2. Use of Box & Pan Brake to fold back and sides	
	3. Use of sandblaster to prepare for spot welding	
	 Use of spot welder to join the corners together Use of soldering torch to solder corners 	
Vocabulary	Bar-fold, Box & Pan Brake, safety hem, Soldering, spot welding, sand blast, pneumatic, a compressor, setting hammer, stake, vise grips, soldering torch, flux and solder	ir
Resources	Materials for this unit are available in the Metals 1 Curriculum Resources shared Google	e Drive.
Assessments	Students will be observed as they complete the steps instructed/demonstrated with ins feedback. Feedback will provide reinforcement of accurate performance and redirection deviation is determined.	tructor n if

Student's produced artifact is evaluated for accuracy and adherence to expected results. Comparison to the teacher generated artifact can aid in understanding compliance and gaps.

	Unit 5: Finishing	Pacing: Week 8
Description	In this unit, students will demonstrate an understanding of finishing for metal.	
Essential Questions	1. What and why surface finishing options are considered for sheet metal?	
	2. How is oil based spray paint properly applied to metal?	
	CT SDE Technology Education Standards	
	Learning Objectives: The student will be able to	
	MAN.03: Demonstrate the methods involved in turning raw materials into usable products	
Standards/ Learning	MAN.03.05 Experiment with the alteration of material characteristic	
Objectives	CT SDE Career and Technical Performance Standards*	
	I. Finishing: Describe various types of available finishes and safety precautions u during the application process.	sed
	31. Identify and apply various metal finishes for interior and exterior, with brush or spr the following: paint and clear coat.	ay for
	Proper application of paint can enhance the overall aesthetics of a project in addition to providing surface protection. Proper ventilation is imperative to the safe application o paint.) f the
Application of	These lessons demonstrate to students the techniques of the proper application of pain sheet metal.	t to
Learning	Students will use demonstrated techniques to further their artifact/project towards con	npletion.
Objectives	 Ensure proper mixing of paint and solvent Use of ventilation and paint board 	
	3. Utilize consistent, even spraying techniques for best results	
	4. Optional enhancements are available such as intentional overspray, shapes and application.	brush
Vocabulary	spray aerosol finish, water based, oil based, paint brush, flammable storage cabinet, ver paint board, solvent, mixing, imperfections (runs, sags, wrinkles)	ntilation,
Resources	Materials for this unit are available in the Metals 1 Curriculum Resources shared Google	e Drive.
A	Student are observed as they are applying finishing with regards to safety and accuracy	,
Assessments	The quality of the finished application will be graded.	

Unit 6: Independent Application of Acquired Skills Week 9		
Description	Apply acquired skills to produce various sheet metal artifacts. Enhance student learning objectives from prior units and allow the student to apply existing knowledge and skills to create various artifacts independently.	
	1. Why is it important to plan a layout before cutting materials?	
Essential Questions	2. Which tools are appropriate for specific material processing tasks and how do we use them properly?	
	CT SDE Technology Education Standards	
	Learning Objectives: The student will be able to	
	MAN.01 Employ engineering design process to achieve desired outcomes	
	MAN.01.01 Describe the process of interpreting and preparing technical drawings and rough drawings and sketches	
Standarde /	MAN.01.02 Demonstrate the process for interpreting technical drawings to extrapolate information from a set of plans using appropriate mathematical functions	
Learning	CT SDE Career and Technical Performance Standards*	
Objectives	C. Design, Measurement, and Layout: Interpret technical drawings, rough drawings and sketches, and the use fractional measurement.	
	13. Describe and identify fractional measurements from a basic plan and assembly drawings.	
	14. Describe and prepare rough drawings and sketches.	
	15. Explain and prepare a cut list or bill of material from a basic plan and assembly drawing.	
	16. Measure accurately to a sixteenth of an inch.	
	*Adapted from CT Engineering and Wood Technology Performance Standards	
	It is important to choose the proper method and technique for proper folding/bending and joining of materials (sheet metal).	
Application of Learning	Students will apply techniques learned in previous lessons to fabricate sheet metal projects	
Objectives	1. Use of Bar-fold to create safety hems	
	2. Use of Box & Pan Brake to fold back and sides	
Vocabulary	orthographic view, isometric, units of measure, gauge, measuring, accuracy and precision, tolerance, layout, defects, dimension line, extension lines, center line, combination square, machinist ruler, layout dye, scribing, scratch awl	
Resources	Materials for this unit are available in the Metals 1 Curriculum Resources shared Google Drive.	
Assessments	Student's produced artifact is evaluated for accuracy and adherence to expected results. Comparison to the teacher generated artifact can aid in understanding compliance and gaps.	

	Unit 7: Aluminum Sand CastingPacing: Weeks 10 - 13
Description	Apply safe techniques to produce aluminum castings.
Essential Ouestions	 How are aluminum castings created and used and why are they important as a manufacturing process? What are the specific steps, tools and techniques used to produce an aluminum sand
	casting?
	CT SDE Career and Technical Performance Standards*
Standards/	E. Material Processing: Identify and describe the various types of processes associated with the metalworking field and the characteristics of metal as a medium.
Objectives	*Adapted from CT Engineering and Wood Technology Performance Standards
	Students will be able to use accepted industry practices to create sand molds for aluminum casting
Application of Learning Objectives	It is important to follow a specific material processing sequence for optimum productivity and safety.
	Additive manufacturing is a significant type of manufacturing that combines materials (in this cast aluminum) into a shape that is identical to a pattern. Some subtractive manufacturing is used as a next step to remove excess material created in the casting process.
	These lessons demonstrate to students the techniques of creating a sand mold that will be filled with molten aluminum. Once the aluminum cools, that solid replica of the pattern can then be removed from the sand.
	Students will use the knowledge and skills from the demonstrated techniques to create an aluminum casting.
Vocabulary	pattern, mold, petrobond, flask, cope, drag, parting compound, riddle, ram, bottom board, strike-off bar, sprue, riser, slick & spoon, funnel, reservoir, gates, blast furnace, crucible, ingot, pyrometer, tongs, crucible shanks, slag
Resources	Materials for this unit are available in the Metals 1 Curriculum Resources shared Google Drive.
Assessments	Student's produced artifact is evaluated for accuracy and adherence to expected results.

	Pacing: Unit 8: Aluminum Finishing 14-16
	Apply finishing techniques to castings from prior unit
Description	Students use accepted industry practices to finish metal products. Students will safely use finishing tools and techniques such as painting, sandering, and buffing as the final step in producing a metal product.
Essential Questions	1. What are the specific steps, tools and techniques used to finish an aluminum sand casting?
	CT SDE Technology Education Standards
	Learning Objectives: The student will be able to
	MAN.03 Demonstrate the methods involved in turning raw materials into usable products
	MAN.03.01 Identify and describe the primary processes for obtaining raw materials
Standards/ Learning	MAN.03.02 Demonstrate the safe and accurate secondary process to create a finished product; forming; separating; combining; assembly; finishing
Objectives	CT SDE Career and Technical Performance Standards*
	B. Machines and Tools: Identify and describe the function of various types of layout hand and power tools.
	8. Identify, use, and maintain the following measuring, layout, and marking tools: steel rule, tape measure, combination square, sliding "T" bevel, and compass.
	*Adapted from CT Engineering and Wood Technology Performance Standards
	Subtractive manufacturing is used to remove excess material created in the casting process.
Application of Learning Objectives	These lessons demonstrate to students the techniques and tools used to remove the excess material that results from the casting process. The surface of the casting is then polished to a reflective shine.
	Students will use the knowledge and skills from the demonstrated techniques to finish an aluminum casting, producing a completed project.
Vocabulary	hacksaw, vixen file, sandpaper, sandpaper grit, buffing wheel, buffing compound, faceshield, vice, wooden blocks, recycling aluminum
Resources	Materials for this unit are available in the Metals 1 Curriculum Resources shared Google Drive.

	Student's produced artifact is evaluated for accuracy and adherence to expected results.
Assessments	Focus for assessment on the students project are:
	1. Trueness of replica from the original pattern.
	2. Ideally void or only minor surface imperfections that are a result of loose sand from the
	casting process.
	3. Removal of gates that allow for filing and sanding that reduce visibility or noticeably,
	ideally with no detectable trace.
	4. Buffed surface that reflects light well, indicating good sanding techniques and
	thoroughness.

	Pacing: Unit 9: Copper Pipe Joining 17
Description	Students use accepted industry practices to connect sections of copper pipe (½") to successfully build a piping loop. Students will safely use hand tools to assemble metal parts into a product.
Essential Questions	 What are the basic copper pipe connections created using fittings with soldering ("sweating") techniques?
Standards/ Learning Objectives	CT SDE Technology Education Standards
	Learning Objectives: The student will be able to
	MAN.03: Demonstrate the methods involved in turning raw materials into usable products MAN.03.03 Apply a variety of manufacturing techniques and processes to create a usable product
	CT SDE Career and Technical Performance Standards*
	G. Joinery: Identify various types of joints and describe the process for preparation and assembly.
Application of Learning Objectives	Copper piping is one of several piping methods commonly used in residential and commercial plumbing. It is important to choose the proper method and technique for proper connection of copper pipe, using fittings (elbows and Tees).
	Students will use the knowledge and skills from the demonstrated techniques to create a copper pipe 'loop'. This 'loop' prompts students to gain some experience with the soldering techniques and allows for the finished product to be pressure tested.
Vocabulary	Pipe, fitting, pipe cutter, flux, solder, soldering or propane torch, steel wool, fitting brush, gloves, ventilation
Resources	Materials for this unit are available in the Metals 1 Curriculum Resources shared Google Drive.
Assessments	Student's produced artifact is tested for quality by pressurizing and examining for leaks.

Pacing: Unit 10: Introduction to CNC Week 18		
Description	Students are introduced to plasma cutting and the use of Computer Numeric Control (CNC) through a demonstration of the process. This is meant to gain interest in more advanced metalworking techniques that are explored more in Metals II.	
Essential Questions	1. What is a plasma cutter and how is it used to cut sheet metal?	
	2. What is Computer Numeric Control (CNC) and how is it used to control manufacturing processes?	
Standards/ Learning Objectives	CT SDE Technology Education Standards	
	Learning Objectives: The student will be able to	
	MAN.03: Demonstrate the methods involved in turning raw materials into usable	
	products MAN.03.03 Apply a variety of manufacturing techniques and processes to create a usable product	
	CT SDE Career and Technical Performance Standards*	
	E. Material Processing: Identify and describe the various types of processes associated with the metalworking field and the characteristics of metal as a medium.	
	23. Identify and select the proper cutting process based on material properties and dimensions.	
	24. Identify how sheet metal gauge affects a material's strength.	
	25. Understanding shearing and its application to cutting and layout operations.	
	*Adapted from CT Engineering and Wood Technology Performance Standards	
Application of Learning Objectives	This unit is meant to be a demonstration that introduces the students to more advanced manufacturing techniques. It is meant to be a 'teaser' or a method to generate interest for students considering Metals II. No required student project results from this unit, however students that are fully complete with previous semester projects can explore an option to produce an independent project using this technique.	
	Instructor will demonstrate the overall steps to generate a computer file that can be translated into a physical product.	
Vocabulary	Plasma cutter, Computer Numeric Control (CNC), non galvanized sheet metal, gauge, G Code, software (EnRoute, Velocity), ventilation, DIN, eye protection	
Resources	Materials for this unit are available in the Metals 1 Curriculum Resources shared Google Drive.	
Assessments	Students will be assessed for their knowledge and understanding of the CNC process.	