

Metalworking Supplemental Program Resources



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Introduction

This document provides supplemental information for the Metalworking program of study. It may be updated or revised as the base program of study, or complementary programs, are updated, added, or removed. Please contact the appropriate Education Programs Professional with any questions.

The Program of Study includes the approved courses, complementary courses, alignment(s) to industry, postsecondary options, and additional information.

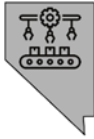
The Equipment List for the Metalworking program of study is included and, if applicable, additional items used only in the complementary course(s) are noted.

The Crosswalks and Alignments connect and support the Metalworking standards for the Manufacturing program of study. Complementary course standards are not listed in the crosswalks and alignments.

Program of Study Information

The following program of study information sheet as well as the program structure tables for the courses are provided to be able to print separately for handouts. The information provided is based on the best available information at the time of this document and will be updated as appropriate.

Metalworking



The Metalworking program provides students with instruction in the various metalworking processes. Areas of study include safety procedures, print reading, measurement, properties of metals, machine operation, metal-fabricating methods, industrial applications, and problem-solving. Students will also be introduced to the principles of metallurgy, metal lathe operation, forging methods, casting process, welding, and heat-treating procedures.

Manufacturing Career Cluster

Manufacturing is focused on planning, managing, and performing the processing of materials into intermediate or final products and related professional and technical support activities such as production planning and control, maintenance and manufacturing, and process engineering.

Postsecondary Options

Certificate/License

- Certificate of Achievement:
 - Manufacturing Machining Technology/Industrial Maintenance
 - Welding Technology
 - Welding Technology: Entry-Level Welder
 - Machine Tool Technology, Welding Technology
- Applied Science Welding (WNC)
- Advanced Level Welder (CSN)
- AAS Manufacturing Machining Tech/Industrial Maintenance (GBC)
- AAS Machining, AAC Manufacturing Technologies, Welding (TMCC)



For additional information on this cluster, please contact:
cteinfo@doe.nv.gov

Website: <https://doe.nv.gov/offices/craleo/cte>

Required Courses

- Metalworking I
- Metalworking II
- Metalworking II Lab

Complementary Courses

- Metalworking Advanced Studies
- CTE Work Experience – Manufacturing
- Industry-Recognized Credential – Metalworking

Work-Based Learning Opportunities

Job Shadowing / Internship / CTE Work Experience/ School-based Enterprise/ Apprenticeship Ready Programs

Career and Technical Student Organization

SkillsUSA/TSA



State Recognized Industry Certifications

Refer to the Governor’s Office of Workforce Innovation’s [Nevada Industry Recognized Credential List](#)

Aligned to Industry			
Occupation	Median Wage Per year	Annual Openings	% Growth
Materials Engineers	\$98,300	1,700	6.0%
Iron Workers	\$57,160.00	9,400	4.0%
Sheet Metal Worker	\$53,440.00	12,300	-1.0%
Plumbers, Pipefitters, and Steamfitters	\$59,880.00	\$48,600	1.0%
Welders, Cutters, Solderers, and Brazers	\$47,010	47,600	2.0%
Quality Control Inspectors	\$38,580	67,800	-3.0%

Source U.S. Bureau of Labor Statistics 2022

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Program Structure for Metalworking

The core course sequencing is provided in the following table. Complementary Courses are available and provided later in this document. The following courses provide a completed program of study. The Lab is a complementary course available concurrently with the Metalworking II course.

Core Course Sequence (R) with Lab Course(s) (C)

Required/ Complementary	Course Title	Abbreviated Name	CIP Code	SCED Subject Area	SCED Course Identifier	SCED Course Level	SCED Unit Credit	SCED Course Sequence	SCED Course Number
R	Metalworking I	METAL WRKG I	48.0511	13	202	G	1.00	12	13202G1.0012
R	Metalworking II	METAL WRKG II	48.0511	13	202	G	1.00	22	13202G1.0022
C	Metalworking II LAB	METAL WRKG II L	48.0511	13	202	E	1.00	22	13202E1.0022

The complementary courses are provided in the following table. **The qualifying program of study must be completed prior to enrolling in the complementary course(s).** A program does not have to utilize the complementary courses for students to complete their program of study.

Required/ Complementary	Course Title	Abbreviated Name	CIP Code	SCED Subject Area	SCED Course Identifier	SCED Course Level	SCED Unit Credit	SCED Course Sequence	SCED Course Number
C	Metalworking Advanced Studies	METAL WRKG AS	48.0511	13	202	E	1.00	11	13202E1.0011
C	Industry Recognized Credential - Metalworking	IRC METALWRKG	48.0511	13	999	E	1.00	11	13999E1.0011
C	CTE Work Experience - Manufacturing	WORK EXPER MANUF	99.0013	13	098	G	1.00	11	13098G1.0011

CIP Code – Classification of Instructional Programs (CIP) Codes

SCED – School Courses for the Exchange of Data that populates the State Infinite Campus System and the System for Accountability Information in Nevada (SAIN)

Course Descriptions

Metalworking I

Prerequisite: None

This course introduces students to a general overview of metalworking processes. Students will gain an understanding of equipment, tools, safety procedures, machine operation, metal-fabricating methods, industrial applications, and problem solving. Students will be introduced to career opportunities and necessary job skills.

Metalworking II

Prerequisite: Metalworking I

This course is a continuation of Metalworking I. This course will enhance students' occupational levels of training, understanding, and skill development in the metal-working processes. Emphasis will be directed toward the principles of metallurgy, metal lathe operation, forging methods, casting process, welding, and heat-treating procedures. Advanced welding methods will be presented as well as career awareness and opportunities in the metals industries. The appropriate use of technology and industry-standard equipment is an integral part of this course.

Metalworking II LAB

Prerequisite: Metalworking II

This course is designed to expand the students' opportunities for applied learning. This course provides an in-depth lab experience that applies the processes, concepts, and principles as described in the classroom instruction. The coursework will encourage students to explore and develop advanced skills in their program area. The appropriate use of technology and industry-standard equipment is an integral part of this course.

Metalworking Advanced Studies

Prerequisite: Completion of Metalworking Program of Study

This course is offered to students who have completed all content standards in the Metalworking program of study and desire to pursue advanced study through investigation and in-depth research. Students are expected to work independently or in a team and consult with their supervising teacher for guidance. The supervising teacher will give directions, monitor, and evaluate the students' topic of study. Coursework may include various work-based learning experiences such as internships and job shadowing, involvement in a school-based enterprise, completion of a capstone project, and/or portfolio development. This course may be repeated for additional instruction and credit.

Industry-Recognized Credential – Metalworking

Prerequisite: Completion of Metalworking Program of Study

This course is offered to students who have completed all content standards in the Metalworking program of study and desire to pursue an Industry-Recognized Credential that aligns with the standards and skills associated with the Metalworking Program of Study. This course is designed to expand the students' opportunities to pursue certification aligned with employment standards in the industry aligned with this program of study. The supervising teacher will provide instruction aligned with the certification requirements, monitor progress toward certification, and provide the students with appropriate testing or certification opportunities associated with the intended Industry-Recognized Credential that is the subject of the course. This course may be repeated for additional instruction and credit.

CTE Work Experience – Manufacturing

Prerequisite: Completion of Level 2 course in the qualifying program of study

This course is designed to expand the students' opportunities for applied learning. This course provides an in-depth CTE work experience that applies the processes, concepts, and principles as described in the classroom instruction. This course will encourage students to explore and develop advanced skills through work-based learning directly related to the program of study. The course must follow NAC 389.562, 389.564, 389.566 regulations.

Equipment List

This recommended list is based upon a classroom size of 25 students. All costs are estimated and may be adjusted once verified and justified by districts with current quotes. No specific equipment vendor or brand names are endorsed due to various possibilities, but school districts should consult with stakeholders to ensure industry-recognized equipment and software are purchased. The intent of this list is to provide school districts with guidance on the equipment needed to implement the state standards for a Metalworking program.

CTE Classroom Equipment

Total: \$1,560

QTY	ITEM DESCRIPTION	UNIT	TOTAL
2	Storage Cabinets (36" x 12" x 72") (lockable)	\$400	\$800
1	Eyewash Station	\$300	\$300
2	Fire Extinguisher	\$130	\$260
1	Sink with Soap Dispenser	\$100	\$100
1	First Aid Kit	\$100	\$100

Program Equipment

Total: \$112,700

QTY	ITEM DESCRIPTION	UNIT	TOTAL
25	Student Computers	\$1,000	\$25,000
1	Teacher Computer (enhanced memory/storage. Download capable)	\$1,500	\$1,500
1	Technology Storage/Charging System	\$2,000	\$2,000
3	Welding Simulators (with software)	\$9,000	\$27,000
1	Pedestal Grinder	\$6,000	\$6,000
3	Welding Stations/Booths getting an email quote	\$3,000	\$9,000
1	Metalworking Lathe	\$3,500	\$3,500
3	Gas Tungsten Arc Welders (GTAW)	\$2,500	\$2,500
3	Cutting Tables	\$1,500	\$4,500
3	Plasma Cutters	\$1,500	\$4,500
2	Drill Presses	\$2,000	\$2,000
1	English Wheel and Stand	\$1,500	\$1,500
1	Metal Shaping Station	\$1,300	\$1,300
6	Gas Metal Arc Welders (GMAW)	\$1,200	\$7,200
8	Shielded Metal Arc Welders (SMAW)	\$1,000	\$8,000
2	Metal Stretchers	\$800	\$1,600

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QTY	ITEM DESCRIPTION	UNIT	TOTAL
1	Storage Cabinet for Sanitized Eye Protection Equipment	\$800	\$800
6	Oxy-fuel Welders/Cutting Equipment	\$600	\$3,600
2	Belt Grinders for Metal	\$600	\$1,200

Instructional Materials

Total:

\$3,000

QTY	ITEM DESCRIPTION	UNIT	TOTAL
25	Student Textbooks Approved CTE Instructional Materials list can be found here .	\$100	\$2,500
1	Teacher Textbook Edition and Resources	\$500	\$500

Instructional Supplies

Total:

\$24,350

QTY	ITEM DESCRIPTION	UNIT	TOTAL
Varies	Personal Safety Equipment (welding hoods, gloves, ear protection, and aprons)	\$5,000	\$5,000
Varies	Metalworking Materials and Tools (fasteners, dyes, scribes, dividers, trammel points, edge gauges, metal forming kits, heavy duty metal bender, seamer tongs, punch and flare tools, etc.)	\$4,000	\$4,000
Varies	Welding Tools (clamps, slag hammers, electrode tip cleaners, flint strikers, etc.)	\$4,000	\$4,000
Varies	Basic Tools (pliers, hammers, screwdrivers, chisels, foot shears/ power shears, hand shears, Beverly shears, Whitney punches, etc.)	\$3,000	\$3,000
Varies	Welding Materials (electrodes, metal, wire, gas, etc.)	\$5,000	\$5,000
Varies	Hand and Power Tools (drills, saws, soapstone, etc.)	\$1,500	\$1,500
Varies	Measurement Tools (tape measures, levels, squares, etc.)	\$750	\$750
Varies	Lab Safety Supplies (glasses, brooms, garbage cans, etc.)	\$500	\$500
Varies	Computer Accessories (cases, covers, etc.) (optional)	\$600	\$600

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Other

Total:

\$1,275

QTY	ITEM DESCRIPTION	UNIT	TOTAL
1	Occupational Safety and Health Administration (OSHA) Instructor Training	\$300	\$300
25	Occupational Safety and Health Administration (OSHA) Student Exams	\$39	\$975

Category Totals:

Classroom Equipment	\$1,560
Program Equipment	\$112,700
Instructional Materials	\$3,000
Instructional Supplies	\$24,350
Other	\$1,275
Estimated Program Total	\$142,885

Crosswalks and Alignments for Program of Study Standards

Crosswalks and alignments are intended to assist the teacher make connections for students between the technical skills within the program and academic standards. The crosswalks and alignments are not intended to teach the academic standards but to assist students in making meaningful connections between their CTE program of study and academic courses. The crosswalks are for the required program of study courses, not the complementary courses.

Crosswalks (Academic Standards)

The crosswalks of the Metalworking Standards show connections with the Nevada Academic Content Standards. The crosswalk identifies the performance indicators in which the learning objectives in the Metalworking program connect with and support academic learning. The performance indicators are grouped according to their content standard and are crosswalked to the Nevada Academic Content Standards in English Language Arts, Mathematics, and Science.

Alignments (Mathematical Practices)

In addition to connections with the Nevada Academic Content Standards for Mathematics, many performance indicators support the Mathematical Practices. The following table illustrates the alignment of the Metalworking Standards Performance Indicators and the Mathematical Practices. This alignment identifies the performance indicators in which the learning objectives in the Metalworking program connect with and support academic learning.

Alignments (Science and Engineering Practices)

In addition to connections with the Nevada Academic Content Standards for Science, many performance indicators support the Science and Engineering Practices. The following table illustrates the alignment of the Metalworking Standards Performance Indicators and the Science and Engineering Practices. This alignment identifies the performance indicators in which the learning objectives in the Metalworking program connect with and support academic learning.

Crosswalks (Common Career Technical Core)

The crosswalks of the Metalworking Standards show connections with the Common Career Technical Core. The crosswalk identifies the performance indicators in which the learning objectives in the Metalworking program connect with and support the Common Career Technical Core. The Common Career Technical Core defines what students should know and be able to do after completing instruction in a program of study. The Metalworking Standards are crosswalked to the Manufacturing Career Cluster™ and the Production Career Pathway.

Crosswalk of Metalworking Program of Study Standards
and the Nevada Academic Content Standards

English Language Arts: Language Standards

Nevada Academic Content Standards		Performance Indicators
L.11-12.6	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.	1.5.2

English Language Arts: Reading Standards for Literacy in Science and Technical Subjects

Nevada Academic Content Standards		Performance Indicators
RST.11-12.2	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	2.1.15
RST.11-12.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.	2.1.1, 2.1.18, 2.1.19, 5.1.1 5.1.2, 5.1.3, 5.1.4, 5.1.5 5.1.6, 5.1.7, 6.1.1, 6.1.2 6.1.3, 6.2.1, 6.2.2, 8.3.1 8.4.4, 9.3.1
RST.11-12.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.	2.1.15, 3.1.2
RST.11-12.5	Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.	2.1.15
RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.	2.1.1, 2.1.2, 2.1.9, 2.1.19 3.1.1, 3.3.1, 3.4.1, 4.1.1 4.1.2, 4.1.3, 4.2.1, 4.2.2 7.1.1, 7.1.2, 7.1.3, 8.1.2 8.5.1, 10.2.1

English Language Arts: Speaking and Listening Standards

Nevada Academic Content Standards		Performance Indicators
SL.11-12.1a	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.	1.1.1, 1.1.2, 1.2.1, 1.2.4 1.4.2, 1.5.2, 2.1.2
SL.11-12.1d	Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.	2.1.18
SL.11-12.2	Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.	1.1.1, 1.1.2, 1.2.1, 1.2.4 1.4.2
SL.11-12.4	Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.	1.1.1, 1.1.2, 1.2.1, 1.2.4 1.4.2, 1.5.2

English Language Arts: Writing Standards for Literacy in Science and Technical Subjects

Nevada Academic Content Standards		Performance Indicators
WHST.11-12.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	1.2.5, 1.4.1, 2.1.1, 2.1.2 2.1.9, 2.1.15, 2.1.16, 3.1.1 3.1.3, 3.1.4, 3.4.1, 4.1.1 4.1.2, 4.1.3, 4.2.1, 4.2.2 5.1.4, 7.1.1, 7.1.2, 7.1.3 8.1.2, 8.5.1, 10.2.1
WHST.11-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.	1.4.4
WHST.11-12.6	Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.	1.4.5
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the	1.1.2, 1.1.3, 1.4.2, 1.4.3 1.5.2

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specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.	
WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.	2.1.15

Math: Geometry – Geometric Measurement and Dimension

Nevada Academic Content Standards		Performance Indicators
GGMD.A.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.	3.2.5

Math: Geometry – Similarity, Right Triangles, and Trigonometry

Nevada Academic Content Standards		Performance Indicators
GSRT.D.9	(+) Derive the formula $A = 1/2 ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.	3.2.5
GSRT.D.11	(+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).	3.2.5

Alignment of Metalworking Standards and the Common Core Mathematical Practices

Common Core Mathematical Practices	Metalworking Performance Indicators
1. Make sense of problems and persevere in solving them.	9.1.1, 9.3.3
2. Reason abstractly and quantitatively.	
3. Construct viable arguments and critique the reasoning of others.	
4. Model with mathematics.	
5. Use appropriate tools strategically.	2.1.6, 2.1.7, 2.2.1, 2.2.2, 2.2.3 2.2.4, 2.2.5, 2.2.6, 2.3.4, 2.3.5 2.4.3, 2.4.5
6. Attend to precision.	7.2.1, 7.2.2, 7.2.3, 7.3.4, 7.3.5 7.4.2, 7.4.4
7. Look for and make use of structure.	
8. Look for and express regularity in repeated reasoning.	

Crosswalks of Metalworking Standards and the Common Career Technical Core

Manufacturing Career Cluster	Performance Indicators
1. Evaluate the nature and scope of the Manufacturing Career Cluster™ and the role of manufacturing in society and in the economy.	
2. Analyze and summarize how manufacturing businesses improve performance.	2.4.1, 2.4.2, 6.2.1
3. Comply with federal, state and local regulations to ensure worker safety and health and environmental work practices.	1.1.1-1.1.3, 6.1.1
4. Describe career opportunities and means to achieve those opportunities in each of the Manufacturing Career Pathways.	6.2.1
5. Describe government policies and industry standards that apply to manufacturing.	1.1.2, 6.1.1
6. Demonstrate workplace knowledge and skills common to manufacturing.	

Production Career Pathway	Performance Indicators
1. Diagnose production process problems and take corrective action to meet production quality standards.	4.1.2-4.1.7, 5.1.1, 5.1.2 5.2.1, 5.2.2
2. Manage safe and healthy production working conditions and environmental risks.	1.1.7, 1.1.11
3. Make continuous improvement recommendations based on results of production process audits and inspections.	6.1.3-6.1.7, 6.2.2, 6.2.3
4. Coordinate work teams when producing products to enhance production process and performance.	
5. Demonstrate the safe use of manufacturing equipment.	1.1.5, 1.2.4, 1.3.4, 4.1.8- 4.1.10, 4.2.1, 4.2.2, 4.3.1 4.3.2, 4.4.1, 4.4.2, 4.5.1 4.5.2, 4.6.1, 4.6.2, 4.7.1 4.7.2, 5.1.3-5.1.5, 5.2.3 5.2.4