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CTE Standards Unpacking
Advanced Welding Technology

Course: Advanced Welding Technology
Course Description: Advanced Welding provides students with opportunities to effectively perform cutting and welding applications of increasing complexity used in the advanced manufacturing industry. Proficient students will build on the knowledge and skills of the Welding Technology course while learning additional welding techniques not covered in previous courses. Specifically, students will be proficient in fundamental safety practices in welding, gas metal arc welding (GMAW), gas tungsten arc welding (GTAW), shielded metal arc welding (SMAW), and quality control methods. Upon completion of the Advanced Welding Technology course, proficient students will be prepared to complete the American Welding Society (AWS) Entry Welder qualification and certification.
Career Cluster: Manufacturing
Prerequisites: Welding Technology
Program of Study Application: Advanced Welding Technology is the second pathway course in the Manufacturing cluster, welding pathway. Welding Technology is a prerequisite for this course. The course may be followed by further dual-enrollment studies or a capstone experience.

<table>
<tr><td colspan="3">INDICATOR #AWT 1: Identify and conform to basic welding safety standards</td></tr>
<tr><td colspan="3">SUB-INDICATOR 1.1 (Webb Level: Two Skill/Concept): Identify and practice the proper industry safety standards.
Examples:</td></tr>
<tr><td>Knowledge (Factual):
-AWS (American Welding Society) Welding safety certification

-Occupational Safety Health Administration (OSHA) certification

-Common welding hazards

-SDS (Safety Data Sheets)

-Proper PPE (Personal Protective Equipment) needed in welding field</td><td>Understand (Conceptual):
-Welding safety and allied cutting processes (AWS)

-General safety guidelines (OSHA)

-Why Welding occupation is a hazardous career

-Correct confined space and tank handling procedures for safe workplace</td><td>Do (Application):
-Completion of simple manufacturing work sheets considering formulas for welding fabrication

-Interpretation of all terms noted in AWS A3.0, Standard Welding Terms and Definition

-Demonstrate and record measurements derived from using measuring devices</td></tr>
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-Confined Spaces and Tank handling procedures		

Benchmarks:
Students will be assessed on their ability to:

- Student will be able to meet requirements for INDICATOR #AWT 21when they have successfully passed a welding terminology and welding math test.
- Construct or layout of parts using the principles of geometry

Academic Connections

ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	-Students will complete math worksheets using formulas and measuring that correspond to welding techniques
G-Co. 12 Make formal geometric constructions with a variety of tools and methods	-Students will use geometric techniques to create a representation of their work
RI.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of text	-Word match

INDICATOR #AWT 2: **Interpret, layout, and fabricate in conformance to fabrication drawings**
SUB-INDICATOR 2.1 (Webb Level: 2 Skill/Concept): Correctly interpret dimensions and locations of components in fabrication drawings.
SUB-INDICATOR 2.2 (Webb Level: 2 Skill/Concept): Correctly scale dimensions in fabrication drawings.
SUB-INDICATOR 2.3 (Webb Level: 2 Skill/Concept): Correctly interpret orthographic and pictorial plan views shown in fabrication drawings.

SUB-INDICATOR 2.4 (Webb Level: 2 Skill/Concept): Recognize and correctly interpret lines and symbols commonly used in fabrication drawings.		
Knowledge (Factual): -Basic design procedures -Appropriate math skills -Blueprint reading	**Understand (Conceptual):** -Proper layout parameters for individual parts -Geometry processes -The scale of a blueprint -Interpret the blueprint	**Do (Application):** -Make a bill of materials to construct and fabricate in accordance to drawing specifications -Lay out structural and other components and their locations to dimensions and tolerances indicated on construction and fabrication drawing. -Use the scale of a drawing to determine locations not explicitly dimensioned -Use the scale of drawing to determine dimension not explicitly shown on the drawing -Interpret two and three-dimensional features found in construction and fabrication drawing -Identify and explain a welding detail drawing -Identify and explain line types -Interpret welding symbols to determine type, geometry, process, extent, and required testing of welds

Benchmarks:
Students will be assessed on their ability to:

- Correctly interpret the blueprint
- Correctly fabricate part from the blueprint

Academic Connections	
ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
G-MG.1 Modeling with Geometry Use geometric shapes, their measures, and their properties to describe objects	-Students will apply geometric principals to their drawings
G-mG.3 Apply geometric methods to solve design problems	-Students can revise their drawings using geometric principals
SL.1. Initiate and participate effectively in a range of collaborative discussions	-Group discussion of blue prints
SL.2. Integrate multiple sources of information presented in diverse formats and media	-Determine correct materials for the project

INDICATOR #AWT 3: **Exhibit knowledge and perform base metal preparation.**		
SUB-INDICATOR 3.1 (Webb Level: 2 Skill/Concept): Prepare base metal for various welding processes.		
Knowledge (Factual): -Material preparation for welding processes -Welding terminology	**Understand (Conceptual):** -Proper preparation of base materials in order to complete welding assignments	**Do (Application):** -Safely use stationary and hand-held grinders -Clean base metal for welding and cutting -Identify and explain joint design -Explain joint design considerations -Mechanically and

		thermally bevel the end of mild steel

Benchmarks:
Students will be assessed on their ability to:

- Perform proper steps for base metal preparation following industry standards

Academic Connections	
ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard): PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials	**Sample Performance Task Aligned to the Academic Standard(s):** -Students will report findings of molecular structure in welding techniques

INDICATOR #AWT 4: **Understand and perform Gas Metal Arc Welding (GMAW) process**

SUB-INDICATOR 4.1 (Webb Level: 2 Skill/Concept): Identify and understand GMAW equipment and setup.

SUB-INDICATOR 4.2 (Webb Level: 2 Skill/Concept): Demonstrate Gas Metal Arc Welding (GMAW) on steel.

Knowledge (Factual):	**Understand (Conceptual):**	**Do (Application):**
-Gas Metal Arc Welding essentials -GMAW classification system -GMAW skill development -Electrodes	-Welding electrical circuit -Welding power supplies -Machine set up -Proper electrode selection -GMAW position applications	-Explain gas metal arc welding (GMAW) safety -Explain the characteristic of welding current and power sources -Demonstrate knowledge of GMAW equipment -Set up GMAW equipment -Identify tools for weld cleaning -Demonstrate fillet welds in one or more positions

		-Demonstrate groove welds in one or more positions -Complete a test plate in the flat weld position

Benchmarks:
Students will be assessed on their ability to:

- Practice appropriate GMAW safety protocol
- Proper GMAW equipment installation
- Demonstrate GMAW skill level

Academic Connections

ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
PS1-3 Plan and carry out an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.	-Students will evaluate forces between particles in GMAW.
PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.	Students will illustrate electrodes and electrical fields as they relate to SMAW equipment

INDICATOR #AWT 5: **Understand and perform Gas Tungsten Arc Welding (GTAW) process**

SUB-INDICATOR 5.1 (Webb Level: 2 Skill/Concept): Understand GTAW equipment and filler metals.

SUB-INDICATOR 5.2 (Webb Level: 2 Skill/Concept): Demonstrate Gas Tungsten Arc Welding (GTAW) process on Steel.

Knowledge (Factual):	**Understand (Conceptual):**	**Do (Application):**
-Gas Tungsten Arc	-Welding electrical circuit	-Explain and

Welding essentials -GTAW classification system -GTAW skill development -Electrodes	-Welding power supplies -Machine set up -Proper electrode selection -GTAW position applications	demonstrate GTAW safety -Identify and explain the function of GTAW equipment, filler metals, and shielding gases -Set up GTAW equipment -Demonstrate fillet welds in one or more positions -Demonstrate groove welds in one or more positions -Complete a test plate in the flat weld position

Benchmarks:
Students will be assessed on their ability to:

- Practice appropriate GTAW safety protocol
- Proper GTAW equipment installation
- Demonstrate GTAW skill level

Academic Connections

ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy	-Students will evaluate the energy transfer during process of GTAW
PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.	-Students will illustrate electrodes and electrical fields as they relate to GTAW equipment.

INDICATOR #AWT 6: **Understand and perform Shielded Metal Arc Welding**

(SMAW) process

SUB-INDICATOR 6.1 (Webb Level: 2 Skill/Concept): Understand SMAW equipment and filler metals.

SUB-INDICATOR 6.2 (Webb Level: 2 Skill/Concept): Demonstrate knowledge of the Shielded Metal Arc Welding (SMAW) process.

Knowledge (Factual):	**Understand (Conceptual):**	**Do (Application):**
-Shielded Metal Arc Welding essentials -SMAW classification system -SMAW skill development -Electrodes	-Welding electrical circuit -Welding power supplies -Demonstrate Machine set up -Proper electrode selection -SMAW position applications	-Explain arc welding (SMAW) safety -Identify and explain the function of SMAW equipment -Identify and explain the function of SMAW filler metals -Set up SMAW equipment -Demonstrate fillet welds in one or more positions -Demonstrate groove welds in one or more positions -Complete a welder qualification test record

Benchmarks:
Students will be assessed on their ability to:

- Practice appropriate SMAW safety protocol
- Proper SMAW equipment installation
- Demonstrate SMAW skill level

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ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
PS1-4 Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy	-Students will evaluate their SMAW model and connect the concept of energy release during a chemical reaction

INDICATOR #AWT 7: **Understand and perform Carbon Arc cutting and gouging process**		
SUB-INDICATOR 7.1 (Webb Level: 2 Skill/Concept): Understand carbon arc equipment.		
SUB-INDICATOR 7.2 (Webb Level: 2 Skill/Concept): Demonstrate Carbon Arc cutting process.		
Knowledge (Factual): -Carbon Arc Cutting and gouging equipment -Safety procedures -Carbon arc cutting and gouging procedure -Electrical current -Appropriate use of carbon arc cutting and gouging	**Understand (Conceptual):** -Carbon arc cutting and gouging process	**Do (Application):** -Explain carbon arc safety -Identify and explain the function of carbon arc equipment -Identify and explain the function of carbon arc cutting and filler removal -Set up carbon arc equipment -Demonstrate removal of filler metal -Demonstrate the cutting of base metals
Benchmarks: *Students will be assessed on their ability to:* • Proper utilization of carbon arc cutting and gouging process		
Academic Connections		

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ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
PS3-3 Design, construct, and test a device that either minimizes or maximizes thermal energy transfer SL.1. Initiate and participate effectively in a range of collaborative discussions	-Students will analyze the thermal energy transfer from Carbon Arc cutting and gouging -Discuss carbon arc safety procedures

INDICATOR #AWT 8: **Identify and demonstrate knowledge of quality control of the welding process including visual and destructive testing.**

SUB-INDICATOR 8.1 (Webb Level: 3 **Strategic Thinking*):*** Demonstrate knowledge of weld quality

Knowledge (Factual):	**Understand (Conceptual):**	**Do (Application):**
-Weld acceptability	-Codes governing welding -Weld defects and discontinuities Nondestructive/destructive examination practices -Welder performance testing tests	-Explain codes governing welding -Explain weld imperfections and their causes -Explain nondestructive examination practices -Explain welder qualification tests -Explain the importance of quality workmanship -Identify common destructive testing methods -Perform visual inspection of fillet weld

Benchmarks:
Students will be assessed on their ability to:

- Document and explain acceptable weld

- Identify and explain weld discontinuity
- Code relevancy exams

Academic Connections	
ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
SL.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.	-Students will discuss practices, uses and identify common welding practices
W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience	-Students can journal practices, uses and identify common welding practices

INDICATOR #AWT 9: **Participate in career exploration activities**

SUB-INDICATOR 9.1 (Webb Level: 2 Skill/Concept): Research career opportunities in the welding pathways.

Knowledge (Factual):	**Understand (Conceptual):**	**Do (Application):**
-Career opportunities and pathways in welding. -Appropriate apprenticeships	-Determine welding career pathways -Education needs for specific career -Determine the importance of Industry certification -Potential job outlook based on location	-Utilizing career exploration software research and write a report on career opportunities in the manufacturing fields -Utilizing career exploration software research educational requirements for a chosen career path -Utilizing career exploration software, update a student's portfolio

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Benchmarks:
Students will be assessed on their ability to:

- Create a list of career opportunities that are linked to career match maker section of www.sdmylife.com
- Presentation on career choice

Academic Connections	
ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
RI.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem	-List of occupations
W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience	-Students will form a presentation on career choices.

INDICATOR #AWT 10: **Demonstrate ethical work behaviors**

SUB-INDICATOR 10.1 (Webb Level: 1 Recall): Follow the following required ethical practices of Manufacturing Industry

Knowledge (Factual):	**Understand (Conceptual):**	**Do (Application):**
-Employer handbook	-Employer mandated work rule	-Complete assignments efficiently and on time -Be aware of the importance of attendance Utilize principles of time management -Present a positive attitude -Work well with peers/supervisor -Be prepared for work

		assignments

Benchmarks:
Students will be assessed on their ability to:

- Role play appropriate and inappropriate actions in the workplace

Academic Connections	
ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):	**Sample Performance Task Aligned to the Academic Standard(s):**
SL.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.	-Role play for interviewing for a job
LS 2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity	-Compare / contrast of good vs bad outcomes

Additional Resources
Lake Area Tech (https://www.lakeareatech.edu/)
Mitchell Tech (https://www.mitchelltech.edu/)
Western Dakota Tech (https://www.wdt.edu/)
South Dakota Industry