

**Arkansas Department of Career Education
Model Framework**

Course Title: Gas Metal Arc Welding

Career Cluster: Manufacturing

Secondary – Skilled and Technical Sciences	
Course Number	495550
CIP Number	48.0508
Grade Level	10-12
Prerequisite	Completion of Welding Technology
Course Type	Elective
Teacher Certification	597
CTSO	SKILLS SKILLS
Facility Requirements	http://arkansasfacilities.arkansas.gov/facilities/academic-facilities-manual
Industry Certifications	http://www.nccer.org

Course Description

This is a program that prepares individuals to apply technical knowledge and skills to join or cut metal surfaces. Includes instruction in arc welding, resistance welding, brazing and soldering, cutting, high-energy beam welding and cutting, solid state welding, ferrous and non-ferrous materials, oxidation-reduction reactions, welding metallurgy, welding processes and heat treating, structural design, safety, and applicable codes and standards

Program Purpose/Structure

Emphasis of this course will be the use of shielded metal arc welders. This course is based on selected modules from Welding Level 1 and Welding Level 2 NCCER curriculum.

Career and Technical Student Organization (CTSO)

SkillsUSA

**Arkansas Department of Career Education
Gas Metal Arc Welding Student Performance Standards**

Course Title: Gas Metal Arc Welding
Course Number: 495550
Course Credit: 1

Gas Metal Arc Welding Indicators: At the completion of the course the student will be able to . . .

- 1.0 Identify and demonstrate welding safety
 - 1.1 Understand the hazards of welding and develop the proper attitude toward safety.
 - 1.2 Develop proper techniques and attitudes toward safe materials handling.
- 2.0 Demonstrate a knowledge of welding materials and metals
 - 2.1 Compare and contrast the physical characteristics, mechanical properties, classification systems, and weldability of common metals and alloys.
 - 2.2 Explain and demonstrate preheating, interpass temperature control, and postheating procedures to preserve weldment strength, ductility, and weld quality.
- 3.0 Identify and apply welding techniques: GMAW and FCAW
 - 3.1 Identify and properly use the required equipment for gas metal arc welding and flux-cored arc welding.
 - 3.2 Perform fillet and open V-groove welds on carbon steel plate using gas metal arc welding (GMAW) and flux-cored arc welding (FCAW) processes in various positions.

Standard 1.0 Identify and Demonstrate Welding Safety			
Performance Indicator 1.1 Understand the hazards of welding and develop the proper attitude toward safety.	Recommended Application/Activity Module 29101-09 Welding Safety	CCSS Standards	CCTC Standards
1.1.1 Identify some common hazards in welding and identify proper PPE used in welding.	<ul style="list-style-type: none"> Complete a JHA Job Hazard Analysis. https://www.osha.gov/Publications/osha3071.pdf Inspect PPE to determine if it is safe to use (PPE should include safety goggles, hard hat, gloves, safety harness, and safety shoes). https://www.osha.gov/Publications/osha3151.html 	W11-12.3	MN3 CRP2
1.1.2 Describe how to avoid welding fumes, how to avoid electric shock when welding and some of the causes of accidents.	<ul style="list-style-type: none"> Demonstrate how to position their head and body while in the welding position. Identify the proper grounding and bonding of the equipment in the lab area. Measure the electrode lead and check for broken insulation no breaks are allowed within 11 feet of the electrode per OSHA standards. 	R11-12.3	MN3
Performance Indicator 1.2 Develop proper techniques and attitudes toward safe materials handling.	Recommended Application/Activity Module 29101-09 Welding Safety	CCSS Standards	CCTC Standards
1.2.1 Identify and explain uses for material safety data sheets.	<ul style="list-style-type: none"> Locate the SDS station and identify a certain product located in the lab area 	R11-12.1	MN3 CRP2
1.2.2 Explain safety techniques for storing and handling cylinders.	<ul style="list-style-type: none"> Demonstrate the safe handling of compressed gas cylinders in the lab area. https://www.osha.gov/SLTC/compressedgasequipment/index.html 		MN5 MN3 CRP2
1.2.3 Describe proper material handling methods.	<ul style="list-style-type: none"> Demonstrate safe lifting procedures http://www.bnl.gov/esh/shsd/pdf/safe%20lifting%20and%2 		MN3 CRP2

	<u>0carrying%20techniques.pdf</u>		
Standard 2.0 Demonstrate a knowledge of Welding Materials and Metals			
Performance Indicator 2.1 Compare and contrast the physical characteristics, mechanical properties, classification systems, and weldability of common metals and alloys.	Recommended Application/Activity Module 29203-09 Characteristics and Mechanical Properties	CCSS Standards	CCTC Standards
2.1.1 Identify and explain the composition and classification of base metals.	<ul style="list-style-type: none"> Explain the difference between ferrous and non-ferrous materials http://www.differencebetween.net/science/chemistry-science/differences-between-ferrous-metals-and-non-ferrous-metals/ 	SL11-12.4	MN6 CRP2
2.1.2 Explain and demonstrate field identification methods for base metals.	<ul style="list-style-type: none"> Conduct a spark test on material. 	R11-12.3	MN6 CRP2
2.1.3 Compare the physical characteristics and mechanical properties of metals.	<ul style="list-style-type: none"> Conduct a magnetic test on material and visually check the paint indicator on material referring to the manufactures base metal mill specs. 	R11-12.3	MN6 CRP2
2.1.4 Compare forms and shapes of structural metals.	<ul style="list-style-type: none"> Explain the difference between cold rolled and hot rolled material angle pipe and tubing 	SL11-12.4	MN6 CRP2
2.1.5 Explain metallurgical considerations for welding metals.	<ul style="list-style-type: none"> Explain and contrast base metal and filler metal tensile strengths. 	R11-12.9	MN6 CRP2
Performance Indicator 2.2 Demonstrate and explain preheating, interpass temperature control, and postheating procedures to preserve weldment strength, ductility, and weld quality.	Recommended Application/Activity Module 29204-09 Preheating and Postheating of Metals	CCSS Standards	CCTC Standards
2.2.1 Explain and demonstrate how to preheat metals.	<ul style="list-style-type: none"> Apply a carbon coating on aluminum plate then preheat the plate until the carbon coating vaporizes bringing the preheat temperature to 800 degrees F. 	R11-12.3	MN6 CRP2
2.2.2 Describe maintaining interpass temperature.	<ul style="list-style-type: none"> Use the appropriate temp stick to maintain the proper interpass temperature on a weldment. 	R11-12.3	MN6 CRP2

2.2.3 Demonstrate postweld heat treatment of metals.	<ul style="list-style-type: none"> Allow weldment to cool to ambient temperature to produce a normalizing postweld heat treatment. 	R11-12.3	MN6 CRP2
2.2.4 Determine the effects of welding on metal	<ul style="list-style-type: none"> Describe the Heat-affected zone (HAZ) in a weld joint and the possible defects that may be created in the process (Cracking) 	R11-12.3 SL11-12.4	MN6 CRP2

Standard 3.0 Identify and apply Welding Techniques: GMAW and FCAW

Performance Indicator 3.1 Identify and properly use the required equipment for gas metal arc welding and flux-cored arc welding.	Recommended Application/Activity Module 29205-09 GMAW and FCAW Equipment and filler Metals	CCSS Standards	CCTC Standards
3.1.1 Explain and demonstrate gas metal arc welding (GMAW) and flux cored arc welding (FCAW) safety.	<ul style="list-style-type: none"> Demonstrate a safe working knowledge of the GMAW and FCAW process. http://www.bocworldofwelding.com.au/media/pdf/file/library/WOWLibrary-GMAW-FCAW-MCAW%20Welding.pdf 	R11-12.9	MN6 CRP2
3.1.2 Identify the characteristics of welding current and power sources.	<ul style="list-style-type: none"> Explain the difference between Constant Current and Constant Voltage and give examples of their uses. 	R11-12.9 SL11-12.4	MN6 CRP2
3.1.3 Demonstrate and explain the use of GMAW and FCAW equipment: <ul style="list-style-type: none"> Spray transfer Globular Short circuiting 	<ul style="list-style-type: none"> Set up a machine for welding and describe the different transfers between base metal and contact tip and explain the mixture of gas required to achieve each. 	R11-12.3 SL11-12.4	MN6 CRP2
3.1.4 Explain the use of GMAW and FCAW shielding gases and filler metals	<ul style="list-style-type: none"> 		
3.1.5 Set up GMAW and FCAW equipment and identify tools for weld cleaning.	<ul style="list-style-type: none"> Set up a machine and identify hand tools as used in the welding industry chipping hammer, wire brush and a combination wrench. 	SL11-12.4	MN6 CRP2
Performance Indicator 3.2 Perform fillet and open V-groove welds on carbon steel	Recommended Application/Activity Module 29206-09 GMAW and FCAW Plate	CCSS Standards	CCTC Standards

<p>plate using gas metal arc welding (GMAW) and flux-cored arc welding (FCAW) processes in various positions.</p>			
<p>3.2.1 Perform GMAW-S (short-circuit) multiple-pass fillet welds on carbon steel plate coupons in multiple positions, using solid or composite wire and shielding gas.</p>	<ul style="list-style-type: none"> • Perform a multi pass T-Joint in all positions. 	<p>R11-12.3</p>	<p>MN6 CRP2</p>
<p>3.2.2 Perform GMAW-S (short-circuit) multiple-pass V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using solid or composite wire.</p>	<ul style="list-style-type: none"> • Perform a multi pass v-groove on carbon steel plate in all positions with and without backing using GMAW-S process. 	<p>R11-12.3</p>	<p>MN6 CRP2</p>
<p>3.2.3 Perform GMAW spray fillet and V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using solid or composite wire and shielding gas.</p>	<ul style="list-style-type: none"> • Perform a multi pass v-groove on carbon steel plate in all positions with and without backing using GMAW spray mode process. 	<p>R11-12.3</p>	<p>MN6 CRP2</p>
<p>3.2.4 Perform FCAW multiple-pass fillet welds on carbon steel plate coupons in multiple positions, using flux cored wire and, if required, shielding gas.</p>	<ul style="list-style-type: none"> • Perform a multi pass fillet weld on carbon steel plate in all positions with backing using FCAW process. 	<p>R11-12.3</p>	<p>MN6 CRP2</p>
<p>3.2.5 Perform FCAW multiple-pass V-groove welds on carbon steel plate coupons in multiple positions (with or without backing), using flux cored wire and, if required, shielding gas.</p>	<ul style="list-style-type: none"> • Perform a multi pass v-groove on carbon steel plate in all positions with backing using FCAW process. 	<p>R11-12.3</p>	<p>MN6 CRP2</p>

Common Core State Standards Grades 9-12

ELA Speaking and Listening Standards Grades 9-10

1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively. **SL9-10.1**
 - a. 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. **SL9-10.1a**
 - b. Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed. **SL9-10.1b**
 - c. Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions. **SL9-10.1c**
 - d. Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented. **SL9-10.1d**
2. Integrate multiple sources of information presented in diverse media or format(e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source. **SL9-10.2**
3. Evaluate a speaker’s point of view, reasoning, and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence. **SL9-10.3**
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. **SL9-10.4**
5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. **SL9-10.5**

ELA Speaking and Listening Standards Grades 11-12

1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively. **SL11-12.1**
 - a. 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. **SL11-12.1a**

- b. Work with peers to promote civil, democratic discussions and decision-making, set clear goals and deadlines, and establish individual roles as needed. **SL11-12.1b**
 - c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives. **SL11-12.1c**
 - d. 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. **SL11-12.1d**
- 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. **SL11-12.2**
 - 3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used. **SL11-12.3**
 - 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. **SL11-12.4**
 - 5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. **SL11-12.5**

ELA Language Grades 9-10

- 4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, choosing flexibly from a range of strategies. **L9-10.4**
 - a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase. **L9-10.4a**
 - b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., analyze, analysis, analytical; advocate, advocacy). **L9-10.4b**
 - c. Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, or its etymology. **L9-10.4c**
 - d. Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary). **L9-10.4d**
- 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. **L9-10.6**

ELA Language Grades 11-12

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, choosing flexibly from a range of strategies. **L11-12.4**
 - a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word’s position or function in a sentence) as a clue to the meaning of a word or phrase. **L11-12.4a**
 - b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., conceive, conception, conceivable). **L11-12.4b**
 - c. Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, its etymology, or its standard usage. **L11-12.4c**
 - d. Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary) **L11-12.4d**
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. **L11-12.6**

Reading Standards for Literacy in Science and Technical Subjects Grades 9-10

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. **R9-10.1**
2. Determine the central ideas or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. **R9-10.2**
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. **R9-10.3**
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 9–10 texts and topics. **R9-10.4**
5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **R9-10.5**
6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. **R9-10.6**
7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. **R9-10.7**
8. Assess the extent to which the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem. **R9-10.8**
9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. **R9-10.9**
10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently. **R9-10.10**

Reading Standards for Literacy in Science and Technical Subjects Grades 11-12

1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. **R11-12.1**
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. **R11-12.2**
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. **R11-12.3**
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. **R11-12.4**
5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. **R11-12.5**
6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. **R11-12.6**
7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. **R11-12.7**
8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. **R11-12.8**
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. **R11-12.9**
10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently. **R11-12.10**

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects Grades 9-10

1. Write arguments focused on discipline-specific content. **W9-10.1**
 - a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. **W9-10.1a**
 - b. Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience’s knowledge level and concerns. **W9-10.1b**
 - c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. **W9-10.1c**
 - d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. **W9-10.1d**
 - e. Provide a concluding statement or section that follows from or supports the argument presented. **W9-10.1e**
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **W9-10.2**

- a. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. **W9-10.2a**
 - b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. **W9-10.2b**
 - c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts. **W9-10.2c**
 - d. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. **W9-10.2d**
 - e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. **W9-10.2e**
 - f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). **W9-10.2f**
3. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. **W9-10.3**
 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **W9-10.4**
 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. **W9-10.5**
 6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. **W9-10.6**
 7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. **W9-10.7**
 8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. **W9-10.8**
 9. Draw evidence from informational texts to support analysis, reflection, and research. **W9-10.9**
 10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. **W9-10.10**

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects Grades 11-12

1. Write arguments focused on discipline-specific content. **W11-12.1**

- a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. **W11-12.1a**
- b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. **W11-12.1b**
- c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. **W11-12.1c**
- d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. **W11-12.1d**
- e. Provide a concluding statement or section that follows from or supports the argument presented. **W11-12.1e**
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **W11-12.2**
 - a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. **W11-12.2a**
 - b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. **W11-12.2b**
 - c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. **W11-12.2c**
 - d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. **W11-12.2d**
 - e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic). **W11-12.2e**
3. Write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results. **W11-12.3**
4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **W11-12.4**
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. **W11-12.5**
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. **W11-12.6**

7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. **W11-12.7**
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 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. **W11-12.8**
9. Draw evidence from informational texts to support analysis, reflection, and research. **W11-12.9**
10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. **W11-12.10**

Common Career and Technical Core Standards

Architecture and Construction Career Cluster

Architecture and Construction Career Cluster Standards

1. Use vocabulary, symbols, and formulas common to architecture and construction. **AC1**
2. Use architecture and construction skills to create and manage a project. **AC2**
3. Comply with regulations and applicable codes to establish and manage a legal and safe workplace/jobsite. **AC3**
4. Evaluate the nature and scope of the Architecture and Construction Career Cluster and the role architecture and construction play in society and the economy. **AC4**
5. Describe the roles, responsibilities, and relationships found in the architecture and construction trades and professions, including labor/management relationships. **AC5**
6. Read, interpret, and use technical drawings, documents, and specifications to plan a project. **AC6**
7. Describe career opportunities and means to achieve those opportunities in each of the Architecture and Construction Career Pathways. **AC7**

Construction Career Pathway (AC-CST)

1. Describe contractual relationships between all parties involved in the building process. **AC-CST1**
2. Describe the approval procedures required for the successful completion of a construction project. **AC-CST2**
3. Implement testing and inspection procedures to ensure successful completion of the construction project. **AC-CST3**
4. Apply scheduling practices to ensure the successful completion of a construction project. **AC-CST4**
5. Apply practices and procedures required to maintain jobsite safety. **AC-CST5**
6. Manage relationships with internal and external parties to successfully complete construction projects. **AC-CST6**
7. Compare and contrast the building systems and components required for a construction project. **AC-CST7**
8. Demonstrate the construction crafts required for each phase of a construction project. **AC-CST8**

9. Safely use and maintain appropriate tools, machinery, equipment, and resources to accomplish construction project goals. **AC-CST9**

Design Preconstruction Career Pathway (AC-DES)

1. Justify design solutions through the use of research documentation and analysis of data. **AC-DES1**
2. Use effective communication skills and strategies (listening, speaking, reading, writing, and graphic communications) to work with clients and colleagues. **AC-DES2**
3. Describe the requirements of the integral systems that impact the design of buildings. **AC-DES3**
4. Apply building codes, laws, and rules in the project design. **AC-DES4**
5. Identify the diversity of needs, values, and social patterns in project design, including accessibility standards. **AC-DES5**
6. Apply the techniques and skills of modern drafting, design, engineering, and construction to projects. **AC-DES6**
7. Employ appropriate representational media to communicate concepts and project design. **AC-DES7**
8. Apply standards, applications, and restrictions pertaining to the selection and use of construction materials, components, and assemblies in the project design. **AC-DES8**

Arts, A/V Technology and Communications Cluster

Arts, A/V Technology and Communications Career Cluster Standards (AR)

1. Analyze the interdependence among the technical and artistic elements of various careers within the Arts, A/V Technology and Communications Career Cluster. **AR1**
2. Analyze the importance of health, safety, and environmental management systems, policies, and procedures common in arts, audio video technology, and communications activities and facilities. **AR2**
3. Analyze the lifestyle implications and physical demands required in the arts, audio/visual technology, and communications workplace. **AR3**
4. Analyze legal and ethical responsibilities required in the arts, audio/visual technology, and communications workplace. **AR4**
5. Describe the career opportunities and means to achieve those opportunities in the Arts, A/V Technology and Communications Career Pathways. **AR5**
6. Evaluate technological advancements and tools that are essential to occupations within the Arts, A/V Technology and Communications Career Cluster. **AR6**

A/V Technology and Film Career Pathway (AR-AV)

1. Describe the history, terminology, occupations, and value of audio, video, and film technology. **AR-AV1**
2. Demonstrate the use of basic tools and equipment used in audio, video and film production. **AR-AV2**
3. Demonstrate technical support skills for audio, video, and film productions. **AR-AV3**
4. Design an audio, video, and/or film production. **AR-AV4**

Printing Technology Career Pathway (AR-PRT)

1. Manage the printing process, including customer service and sales, scheduling, and quality control. **AR-PRT1**
2. Demonstrate the production of various print, multimedia, or digital media products. **AR-PRT2**
3. Perform the finishing and distribution operations related to the printing process. **AR-PRT3**

Telecommunications Career Pathway (AR-TEL)

1. Demonstrate the use telecommunications terminology, tools, and test equipment. **AR-TEL1**
2. Demonstrate telecommunications installation processes using appropriate tools, materials, schematics, diagrams, blueprints, and industry specific codes and regulations. **AR-TEL2**
3. Demonstrate decision making, problem-solving techniques, and communication skills when providing services for customers. **AR-TEL3**
4. Demonstrate the installation, repair, and delivery of network systems. **AR-TEL4**

Visual Arts Career Pathway (AR-VIS)

1. Describe the history and evolution of visual arts and its role in and impact on society. **AR-VIS1**
 2. Analyze how the application of visual arts elements and principles of design communicate and express ideas. **AR-VIS2**
- Analyze and create two and three-dimensional visual art forms using various media. **AR-VIS3**

Government & Public Administration Career Cluster

Government & Public Administration Career Cluster Standards (GV)

1. Explain the purpose and functions of government and public administration and the application of democratic principles in the process of governmental and administrative policymaking. **GV1**
2. Analyze the systemic relationships of government and public administration agencies. **GV2**
3. Describe health, safety, and environmental management systems, as well as policies and procedures in government and public administration agencies. **GV3**
4. Describe the implementation of plans and policies to respond to public health, safety, and environmental needs in government and public administration agencies. **GV4**
5. Describe career opportunities and the means to achieve those opportunities in each of the Government and Public Administration Career Pathways. **GV5**
6. Explain the administration of human, financial, material, and information resources in government and public agencies. **GV6**

National Security Career Pathway (GV-SEC)

1. Instruct persons who will perform tasks relating to national homeland security. **GV-SEC1**
2. Describe the appropriate duties, responsibilities, and authority of a national security agency's personnel at all levels. **GV-SEC2**

3. Describe the leadership characteristics necessary to ensure compliance with rules of engagement and applicable ethical standards. **GV-SEC3**
4. Collect and analyze information from within and outside the United States to assess threats and opportunities regarding national security. **GV-SEC4**
5. Develop strategies to defend against and respond to the effects of chemical, biological, radiological, nuclear (CBRN), or other emergent events. **GV-SEC5**

Health Science Career Cluster

Health Science Career Cluster Standards (HL)

1. Determine academic subject matter, in addition to high school graduation requirements, necessary for pursuing a health science career. **HL1**
2. Explain the healthcare worker's role within their department, their organization, and the overall healthcare system. **HL2**
3. Identify existing and potential hazards to clients, coworkers, visitors, and self in the healthcare workplace. **HL3**
4. Evaluate the roles and responsibilities of individual members as part of the healthcare team and explain their role in promoting the delivery of quality health care. **HL4**
5. Analyze the legal and ethical responsibilities, limitations, and implications of actions within the healthcare workplace. **HL5**
6. Evaluate accepted ethical practices with respect to cultural, social, and ethnic differences within the healthcare workplace. **HL6**

Health Informatics Career Pathway (HL-HI)

1. Communicate health information accurately and within legal and regulatory guidelines, upholding the strictest standards of confidentiality. **HL-HI1**
2. Describe the content and diverse uses of health information. **HL-HI2**
3. Demonstrate the use of systems to capture, retrieve, and maintain confidential health information from internal and external sources. **HL-HI4**

Therapeutic Services Career Pathway (HL-THR)

1. Utilize communication strategies to answer patient/client questions and concerns on planned procedures and goals. **HL-THR1**
2. Communicate patient/client information among healthcare team members to facilitate a team approach to patient care. **HL-THR2**
3. Utilize processes for assessing, monitoring, and reporting patient/clients' health status to the treatment team within protocol and scope of practice. **HL-THR3**
4. Evaluate patient/client needs, strengths, and problems in order to determine if treatment goals are being met. **HL-THR4**

Law, Public Safety, Corrections & Security Career Cluster

Law, Public Safety, Corrections & Security Career Cluster Standards (LW)

1. Formulate ideas, proposals, and solutions to ensure effective and efficient delivery of safety and/or security services to targeted consumers. **LW1**
2. Assess and implement measures to maintain safe and healthy working conditions in a law and public safety workplace. **LW2**
3. Conduct work tasks in accordance with employee rights and responsibilities and employers' obligations concerning occupational safety and health. **LW3**
4. Analyze laws, ordinances, regulations, and organizational rules that apply to careers in law, public safety, security, and corrections. **LW4**
5. Describe career opportunities and means to achieve those opportunities in each of the Law, Public Safety, Corrections, and Security Career Pathways. **LW5**
6. Analyze the nature and scope of Law, Public Safety, Corrections, and Security Career Cluster and the role of law, public safety, corrections and security in society and the economy. **LW6**

Law Enforcement Services Pathway (LW-ENF)

1. Utilize writing skills to produce coherent and focused technical communications to complete incident reports common to law enforcement. **LW-ENF1**
2. Demonstrate the operation of law enforcement communication equipment. **LW-ENF2**
3. Assess hostile situations and utilize the appropriate anger/conflict management strategies to resolve law enforcement problems. **LW-ENF3**
4. Model behaviors that exhibit integrity and a commitment to ethical behavior required of law enforcement professionals. **LW-ENF4**
5. Describe the limits and variations of interrogation procedures that ensure protection of rights for both U.S. citizens and noncitizens in the course of providing law enforcement services. **LW-ENF5**
6. Describe law enforcement procedures used to enforce state and local alcohol and beverage control laws and ordinances. **LW-ENF6**
7. Demonstrate civil law enforcement procedures and protocols for serving writs, warrants, and summons. **LW-ENF7**
8. Demonstrate established procedures and protocols that ensure constitutional rights. **LW-ENF8**
9. Explain the role of law enforcement in the U.S. legal system. **LW-ENF9**
10. Demonstrate appropriate interpersonal skills for dealing with individuals in a law enforcement situation. **LW-ENF10**
11. Exhibit knowledge of state and local laws and law enforcement procedures to enforce driving under the influence (DUI) violations. **LW-ENF11**
12. Present testimony in legal proceedings in accordance with courtroom procedure. **LW-ENF12**
13. Plan, develop, implement, manage, and evaluate community crime and loss prevention programs. **LW-ENF13**
14. Explain the appropriate techniques for managing crisis situations in order to maintain public safety. **LW-ENF14**

15. Implement crowd management strategies and skills as a law enforcement professional in order to maintain control over large gatherings. **LW-ENF15**
16. Demonstrate procedures and protocols used to address domestic violence. **LW-ENF16**
17. Demonstrate motor vehicle traffic stops in compliance with established procedures and laws. **LW-ENF17**
18. Demonstrate protocols and procedures designed for handling and managing explosives and hazardous material incidents. **LW-ENF18**
19. Demonstrate the procedures used to properly protect, document, and process the crime scene and all related evidence. **LW-ENF19**
20. Conduct interviews and interrogations using proper procedures outlined for law enforcement personnel to ensure the protection of individual rights and effective information gathering. **LW-ENF20**
21. Demonstrate techniques and protocols for safely responding to crimes in progress. **LW-ENF21**
22. Utilize appropriate procedures to assist individuals requiring special assistance from law enforcement personnel (e.g., mental disorders, physical disabilities, and communication disorders). **LW-ENF22**
23. Demonstrate protocols involved with juvenile victims and offenders in order to protect their rights. **LW-ENF23**
24. Investigate and document a motor vehicle accident in compliance with prescribed procedures. **LW-ENF24**
25. Evaluate situations that require the use of force and demonstrate the appropriate level of force necessary. **LW-ENF25**
26. Describe the signs and symptoms of possible child abuse and neglect. **LW-ENF26**
27. Describe the behavioral symptoms of drug use and the inherent dangers associated with handling drug users. **LW-ENF27**
28. Demonstrate the use of speed measuring equipment in the enforcement of traffic laws. **LW-ENF28**
29. Examine the various law enforcement issues involved in disaster preparedness and response systems. **LW-ENF29**
30. Describe the key law enforcement functions and techniques of critical infrastructure protection used to assure protection of potential targets of terrorism and/or natural disasters. **LW-ENF30**
31. Demonstrate the use of intelligence analysis techniques and procedures to deter crime and implement homeland security initiatives. **LW-ENF31**
32. Explain procedures for protecting victims' rights and the use of witness protection plans. **LW-ENF32**
33. Demonstrate procedures for conducting building searches. **LW-ENF33**
34. Explain the role forensics computer forensics plays in the resolution of crimes encountered in law enforcement. **LW-ENF34**

Manufacturing Career Cluster

Manufacturing Career Cluster Standards (MN)

1. Evaluate the nature and scope of the Manufacturing Career Cluster and the role of manufacturing in society and in the economy. **MN1**
2. Analyze and summarize how manufacturing businesses improve performance. **MN2**
3. Comply with federal, state, and local regulations to ensure worker safety and health and environmental work practices. **MN3**
4. Describe career opportunities and the means to achieve those opportunities in each Manufacturing Career Pathways. **MN4**

5. Describe government policies and industry standards that apply to manufacturing. **MN5**
6. Demonstrate workplace knowledge and skills common to manufacturing. **MN6**

Maintenance, Installation and Repair Career Pathway (MN-MIR)

1. Demonstrate maintenance skills and proficient operation of equipment to maximize manufacturing performance. **MN-MIR1**
2. Demonstrate the safe use of manufacturing equipment to ensure a safe and healthy environment. **MN-MIR2**
3. Diagnose equipment problems and effectively repair manufacturing equipment. **MN-MIR3**
4. Investigate and employ techniques to maximize equipment performance. **MN-MIR4**
5. Implement a preventative maintenance schedule to maintain manufacturing equipment, tools, and workstations. **MN-MIR5**
6. Implement an effective, predictive, and preventive manufacturing equipment maintenance program. **MN-MIR6**

Production Career Pathway (MN-PRO)

1. Diagnose production process problems and take corrective action to meet production quality standards. **MN-PRO1**
2. Manage safe and healthy production working conditions and environmental risks. **MN-PRO2**
3. Make continuous improvement recommendations based on results of production process audits and inspections. **MN-PRO3**
4. Coordinate work teams when producing products to enhance production process and performance. **MN-PRO4**
5. Demonstrate the safe use of manufacturing equipment. **MN-PRO5**

Transportation, Distribution, & Logistics Career Cluster

Transportation, Distribution, & Logistics Career Cluster Standards (TD)

1. Describe the nature and scope of the Transportation, Distribution, and Logistics Career Cluster and the role of transportation, distribution and logistics in society and the economy. **TD1**
2. Describe the application and use of new and emerging advanced techniques to provide solutions for transportation, distribution, and logistics problems. **TD2**
3. Describe key operational activities required of successful transportation, distribution, and logistics facilities. **TD3**
4. Identify governmental policies and procedures for transportation, distribution, and logistics facilities. **TD4**
5. Describe transportation, distribution, and logistics employee rights and responsibilities and employers' obligations concerning occupational safety and health. **TD5**
6. Describe career opportunities and means to achieve those opportunities in each of the Transportation, Distribution, and Logistics Career Pathways. **TD6**

Facility and Mobile Equipment Maintenance Career Pathway (TD-MTN)

1. Develop preventative maintenance plans and systems to keep facility and mobile equipment inventory in operation. **TD-MTN1**
2. Design ways to improve facility and equipment system performance. **TD-MTN2**

Common Career and Technical Core Career Ready Practices (CCTC CRP)

1. Act as a responsible and contributing citizen and employee. **CRP1**
2. Apply appropriate academic and technical skills. **CRP2**
3. Attend to personal health and financial well-being. **CRP3**
4. Communicate clearly, effectively, and with reason. **CRP4**
5. Consider the environmental, social and economic impacts of decisions. **CRP5**
6. Demonstrate creativity and innovation. **CRP6**
7. Employ valid and reliable research strategies. **CRP7**
8. Utilize critical thinking to make sense of problems and persevere in solving them. **CRP8**
9. Model integrity, ethical leadership, and effective management. **CRP9**
10. Plan education and career path aligned to personal goals. **CRP10**
11. Use technology to enhance productivity. **CRP11**
12. Work productively in teams while using cultural/global competence. **CRP12**