2005 Mississippi Curriculum Framework

Secondary Welding Theory and Applications

(Program CIP: 48.0508 – Welding Technology/Welder

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Academic Standards Mississippi Department of Education Subject Area Testing Program

Workplace Skills for the 21st Century Secretary's Commission on Achieving Necessary Skills

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Foreword

Secondary vocational-technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and instructors are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act III, 1998; and No Child Left Behind Act of 2001).

Each secondary vocational-technical course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Unit Number and Title
- Suggested Time on Task - An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80 percent of the time in the course.
- Competencies and Suggested Objectives
  - A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies.
  - The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.
- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies which reflect active learning methodologies. Instructors should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.
- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, instructors should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.

- Integrated Academic Topics, Workplace Skills, Technology Standards, and Occupational Standards - This section identifies related academic topics as required in the Subject Area Assessment Program (SATP) in Algebra I, Biology I, English II, and U. S. History from 1877, which are integrated into the content of the unit. It also identifies the general workplace skills as identified in the Secretary's Commission on Achieving Necessary Skills (SCANS) report as being critical for all workers in the 21st Century. In addition, national technology standards and occupational skills standards associated with the competencies and suggested objectives for the unit are also identified.
- References - A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

Table of Contents

Program Description

The Welding Theory and Applications curriculum is designed to prepare the students for entry level employment in the field of welding and fabrication. Students in Welding I complete study in occupational orientation and safety, basic math, introduction to blueprints (welding symbols), hand and power tools, Oxy/Fuel operations, and shielded metal arc welding (SMAW). Students in Welding II complete study in occupational orientation and safety, advanced shielded metal arc welding (SMAW), semi-automatic arc welding [gas metal arc welding and flux-cored arc welding (GMAW/FCAW)], gas tungsten arc welding (GTAW), carbon arc cutting principles and practices (CAC-A), plasma arc cutting (PAC), and employability skills.

The welding competencies required in this curriculum were developed to coincide with Contren Core/Welding I and II. The contributions of this resource are hereby acknowledged.

Certification by the National Center for Construction Education and Research (NCCER):

This curriculum has been aligned to modules in the Wheels of Learning program as endorsed by the National Center for Construction Education and Research (NCCER). Students who study this curriculum using the Wheels of Learning materials under the supervision of an instructor who has been certified by the NCCER are eligible to be tested on each module. Students who successfully pass these tests may be certified to the NCCER by the instructor and will receive documentation from NCCER.

Course Outline

Welding I

Course CIP Code: 48.0508

Unit	Title	Hours
Unit 1:	Introduction and Orientation	10.0
Unit 2:	Basic Safety	15.0
Unit 3:	Basic Math	15.0
Unit 4:	Introduction to Blueprints (Welding Symbols)	25.0
Unit 5:	Hand and Power Tools	10.0
Unit 6:	Basic Rigging	20.0
Unit 7:	Base Metal Preparation and Weld Quality	10.0
Unit 8:	Oxy/Fuel Operations	50.0
Unit 9:	Shielded Metal Arc Welding (SMAW)	100.0

Welding II

Course CIP Code: 48.0517

Unit	Title	Hours
Unit 1:	Introduction, Orientation, and Employability Skills	15.0
Unit 2:	Basic Safety (Review)	10.0
Unit 3:	Advanced Base Metal Preparation and Weld Quality	20.0
Unit 4:	Advanced Shielded Metal Arc Welding (SMAW)	110.0
Unit 5:	Semi-Automatic Arc Welding (GMAW/FCAW)	60.0
Unit 6:	Gas Tungsten Arc Welding (GTAW)	40.0
Unit 7:	Carbon Arc Cutting Principles and Practices	10.0
Unit 8:	Plasma Arc Cutting (PAC)	10.0

Welding I
Unit 1: Introduction and Orientation (10 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Describe local program and vocational center policies and procedures. a. Describe local program and vocational center policies and procedures including dress code, attendance, academic requirements, discipline, and transportation regulations.	**Teaching:** • Present local program and vocational center policies and procedures. • Students will read the handbook to become aware of what is expected of them in relation to the policies and procedures of the school. This will include dress code, attendance, academic requirements, discipline, and transportation regulations. Students will work together in pairs. A student with a higher reading ability will team up with a student with a lower reading ability to get a better understanding of the school's program policies and procedures.[E2, E3, E8] **Assessment:** • Students will have a written test on applicable policies and procedures. • Assess student orientation knowledge through instructor observations and written unit test. File completed test to document student mastery of the school and program policies and procedures.
2. Describe employment opportunities and responsibilities. a. Describe employment opportunities including potential earnings, employee benefits, job availability, place of employment, working conditions, and educational requirements. b. Describe basic employee responsibilities.	**Teaching:** • Students will use career software, such as Choices, to measure their aptitudes and abilities for particular careers.[E3, E8] • Students will use the Internet to research a list of careers for which they will be qualified upon program completion.[E2, E3, E4, E5, E10] • Students will use available resources (college catalogs and college websites) to research information about postsecondary educational opportunities.[E2, E3, E4, E5, E10] • Students will select a career in the field and outline educational and skill requirements, expected job growth and entry-level salaries.[E1, E3, E8, E9]

	Assessment: • Assessment will be determined by matching test for definitions and the level of success regarding the Contren activities. Lessons involving writing and math skill will be integrated with the appropriate department. • Use a checklist to evaluate the campaign speech and poster. • Use a checklist to evaluate the presentation. • Review career software printout to assess student aptitudes and abilities.
3. Explore leadership skills and personal development opportunities provided students by student organizations to include SkillsUSA. a. Demonstrate effective teambuilding and leadership skills. b. Practice appropriate work ethics.	**Teaching:** • Discuss the role of a team member and leader. Assign the students roles within a team and have them role play a situation in which there is a conflict which must be resolved. Utilize the lessons from SkillsUSA, Contren Tools for Success, or other resources to provide additional training.[E3, E8] • Discuss appropriate work ethics standards. Have the students list what they believe to be the most common problems among the welding profession. **Assessment:** • Assess the role play using a checklist for documentation. • Lessons from other resources should be assessed according to the recommended resource guide.
4. Demonstrate the ability to follow verbal and written instructions and communicate effectively for job situations.	**Teaching:** • Have the students perform an activity involving verbal instructions. Divide the students into groups and have one team be the customer and the other be the supervisor. The customer will describe the project and the supervisor will have to provide a brief plan for the fabrication of the project. Have the groups switch roles and the customer will provide the supervisor with a written plan and blueprint. The supervisor will describe the procedure for fabrication of the project.[E2, E3, E4, E8]

	Assessment: • The lesson will be assessed using a presentation rubric and a checklist for the written projects.
5. Discuss the history of welding to include materials, terminology, and techniques.	**Teaching:** • Utilize the Contren Welding Level I Orientation to the Trade Unit to discuss the history of welding. Have students research the history of welding and develop a short presentation on each topic. Students will present to the class.[H1, H2] • The instructor will discuss a handout on welding terminology and welding definitions. Students will quiz each other on terminology and definitions. **Assessment:** • Assess the presentation using a presentation checklist. • Terminology and definitions will be assessed by dividing the students into several groups. The groups will quiz each other to see which group can answer the most questions correctly.

STANDARDS

Contren Learning Series Best Practices

SAF1 Identify the responsibilities and personal characteristics of a professional craftsperson.
SAF2 Explain the role that safety plays in the construction crafts.
SAF3 Describe what job-site safety means.
SAF4 Explain the appropriate safety precautions around common job-site hazards.
SAF5 Demonstrate the use and care of appropriate personal protective equipment.
SAF5 Follow safe procedures for lifting heavy objects.
SAF6 Describe safe behavior on and around ladders and scaffolds.
SAF7 Explain the importance of the HazCom (Hazard Communication Standard) requirement and MSDS (Material Safety Data Sheets).
SAF8 Describe fire prevention and fire fighting techniques.
SAF9 Define safe work procedures around electrical hazards.
COM1 Demonstrate the ability to understand information and instructions that are presented in both written and verbal form.
COM2 Demonstrate the ability to communicate effectively in on-the-job situations using written and verbal skills.
EMP1 Explain the construction industry, the role of the companies that make up the industry, and the role of individual professionals in the industry.

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EMP2 Demonstrate critical thinking skills and the ability to solve problems using those skills.
EMP3 Demonstrate knowledge of computer systems and explain common uses for computers in the construction industry.
EMP4 Demonstrate effective relationship skills with teammates and supervisors, exhibit the ability to work on a team, and demonstrate appropriate leadership skills.
EMP5 Be aware of workplace issues such as sexual harassment, stress, and substance abuse.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.
H1 Explain how geography, economics, and politics have influenced the historical development of the United States in the global community.
H2 Describe the impact of science and technology on the historical development of the United States in the global community.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

Suggested References

Althouse, A., Turnquist, C., Bowditch, W., Bowditch, K., & Bowditch, M. (2003). *Modern welding*. Tinley Park, IL: Goodheart-Willcox.

Cary, H. (2002). *Modern welding technology* (5th ed.). Upper Saddle River, NJ: Prentice Hall.

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Welding I
Unit 2: Basic Safety **(15 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Describe general safety rules for working in a shop/lab and industry. a. Describe how to avoid on-site accidents. b. Explain the relationship between housekeeping and safety. c. Explain the importance of following all safety rules and company safety policies. d. Explain the importance of reporting all on-the-job injuries, accidents, and near misses. e. Explain the need for evacuation policies and the importance of following them. f. Explain the employer's substances abuse policy and how it relates to safety. g. Explain the safety procedures when working near pressurized or high temperature.	**Teaching:** **This can be used for the entire unit.** • Identify, discuss, and demonstrate terms, rules, and procedures related to shop/lab and industry safety (Contren Core Text Basic Safety Unit and Level I Orientation).[E3, E8] • Required written tests will follow each section of guidelines for safety rules and procedures. • Provide the students with a list of terms and have them define the terms. Pair the students to quiz each other on the definitions in preparation for a written exam.[E2, E3, E4, E8] • Use the guidelines provided for personal safety (i.e., clothing, jewelry, hair, eyes, and ears). Divide the students into pairs and assign each pair one of the guidelines. Each pair will demonstrate the "do's and don'ts" of the guideline.
2. Identify and apply safety around welding operations. a. Use proper safety practices when welding or working around welding operations. b. Use proper safety practices when welding in or near trenches and excavations. c. Explain the term *proximity work*.	• Have an industry speaker present to the class the necessity of safety in the work environment. The students will write a summary of the presentation.[E1, E2, E9]
3. Identify and explain use of various barriers and confinements. a. Explain the safety requirements for working in confined areas. b. Explain and practice lockout/tagout procedures. c. Explain the different barriers and barricades and how they are used. d. Recognize and explain personal protective equipment. e. Inspect and care for personal protective equipment.	• Divide the students into teams and have them develop scenarios of hazards and accidents using the Contren Series Core Text, Basic Safety Unit and Level I Orientation Unit, trade publications, and the Internet. This will include tools, spills, working around welding, improper use of barriers, ladders or scaffolds, use of MSDS information, fires, and electrical situations. In a game type situation, one team will read a scenario and the other teams will compete to be the first to provide the proper safety measures which should have been used to prevent the hazardous situation or accident. Points will be awarded to the teams with the correct answers.[E2, E4] • Required written tests will follow each

4. Explain lifting and the use of ladders and scaffolds. a. Identify and explain the procedures for lifting heavy objects. b. Inspect and safely work with various ladders and scaffolds.	section of guidelines for safety rules and procedures. • NOTE: SAFETY IS TO BE TAUGHT AS AN ONGOING PART OF THE COURSE THROUGHOUT THE YEAR.
5. Explain the Material Safety Data Sheet (MSDS). a. Explain the function of the MSDS. b. Interpret the requirements of the MSDS.	**Assessment:** • Student participation will be monitored by the instructor and the written exam will be graded. The student must achieve 100% accuracy.
6. Explain fires. a. Explain the process by which fires start. b. Explain fire prevention of various flammable liquids. c. Explain the classes of fire and the types of extinguishers.	• The do's and don'ts exercise will be critiqued with a peer review. • The summary of the speaker's presentation will be critiqued using a rubric. • The teams will be rewarded according the points earned from the game. This could be extra points, classroom privileges, etc.
7. Explain safety in and around electrical situations. a. Explain injuries when electrical contact occurs. b. Explain safety around electrical hazards. c. Explain action to take when an electrical shock occurs.	• Written exams will be graded.

STANDARDS

Contren Learning Series Best Practices

SAF1 Identify the responsibilities and personal characteristics of a professional craftsperson.
SAF2 Explain the role that safety plays in the construction crafts.
SAF3 Describe what job-site safety means.
SAF4 Explain the appropriate safety precautions around common job-site hazards.
SAF5 Demonstrate the use and care of appropriate personal protective equipment.
SAF5 Follow safe procedures for lifting heavy objects.
SAF6 Describe safe behavior on and around ladders and scaffolds.
SAF7 Explain the importance of the HazCom (Hazard Communication Standard) requirement and MSDS (Material Safety Data Sheets).
SAF8 Describe fire prevention and fire fighting techniques.
SAF9 Define safe work procedures around electrical hazards.

WWS1 Identify some common hazards in welding.
WWS2 Explain and identify proper personal protection used in welding.
WWS3 Demonstrate how to avoid welding fumes.
WWS4 Explain some of the causes of accidents.
WWS5 Identify and explain uses for material safety data sheets.
WWS6 Demonstrate safety techniques for storing and handling cylinders.
WWS7 Explain how to avoid electric shock when welding.
WWS8 Demonstrate proper material handling methods.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools

T6 Technology problem-solving and decision-making tools

Suggested References

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Cary, H. (2002). *Modern welding technology* (5th ed.). Upper Saddle River, NJ: Prentice Hall.

Jeffus, L. (1997). *Welding principles and application* (4th ed.). Clifton Park, NY: Thompson Delmar Learning.

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National Center for Construction Education and Research. (2001). *Welding level II.* Upper Saddle River, NJ: Pearson Prentice Hall.

Welding I
Unit 3: Basic Math **(15 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Apply the four basic math skills with whole numbers, fractions, and percent. a. Add, subtract, multiply, and divide whole numbers, decimals, and fractions. b. Convert whole numbers to fractions, and convert fractions to whole numbers. c. Convert decimals to percent, and convert percent to decimals. d. Convert fractions to decimals. e. Convert fractions to percent.	**Teaching:** • Have students complete a short pretest to apply the four basic math skills with whole numbers, fractions, and percent (may use Contren Core Text, Basic Math Unit).[A1, A5] • Give students the correct answers to problems, and ask at least one student who got the answers for whole numbers correct to write the problems on the chalkboard or a piece of chart paper. Have students who did not get the problems correct listen as the student at the board or chart paper works the problems. Do this procedure for fractions and percent as well, having students rotate through the skills until each student has spent time with each set of problems. Have a different student lead the discussion each time students rotate so that the students who are just learning how to work the problems have a chance to teach the other students.[E2, E4, E5] • Provide students with additional problems to apply the four basic math skills with whole numbers, fractions, and percent while working in small groups and then alone.[A1, A5] **Assessment:** • Monitor group work as students perform calculations using a group participation assessment rubric, to include group discussions, on-task behavior, helping others, and listening. • Evaluate students on a posttest with whole number, fraction, and percent problems.
2. Use the metric system. a. Use a standard and metric ruler to measure. b. Explain what the metric system is and its importance.	**Teaching:** • Discuss the metric system and its importance. • Divide students into groups and have them design a small welding project appropriate for the program, including dimensions in standard and metric measurements.[A1]

c. Recognize and use metric units of length, weight, volume, and temperature.	• Have students use stiff paper (or materials in the shop) to build a simple model and measure the pieces using both standard and metric rulers to ensure that the model is to proper scale with the design.[A2] • Distribute a variety of metric measuring tools for length, weight, volume, and temperature. Have students measure assigned materials using the appropriate tools and record the measurements.[A2] • Have each student write or type (if technology resources are available) a paper comparing the use of the standard and metric systems and proposing why the United States should or should not use the metric system.[E1, E9, E10] **Assessment:** • Compare design specifications to the constructed model to ensure that measurements are correct. • Evaluate each student's measurements for accuracy. • Evaluate each student's paper for content as well as grammar and organization using a rubric.
3. Apply basic mathematics for welding. a. Calculate area and volume of simple geometric figures. b. Apply basic math to solve simple geometric figures and problems.	**Teaching:** • Discuss and demonstrate the basic mathematic applications in welding.[A1, A3, A5] • Have students apply the applications in solving real work-related problems using the Contren Welding Level 1 Unit or other materials.[A1, A3, A5] **Assessment:** • Assessment of the problems will be Contren examinations and performance examinations.

STANDARDS

Contren Learning Series Best Practices

MAT1 Add, subtract, multiply, and divide whole numbers, with and without a calculator.
MAT2 Use a standard ruler and a metric ruler to measure.

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MAT3 Add, subtract, multiply, and divide fractions.
MAT4 Add, subtract, multiply, and divide decimals, with and without a calculator.
MAT5 Convert decimals to percents and percents to decimals.
MAT6 Convert fractions to decimals and decimals to fractions.
MAT7 Explain what the metric system is and how it is important in the construction trade.
MAT8 Recognize and use metric units of length, weight, volume, and temperature.
MAT9 Recognize some of the basic shapes used in the construction industry and apply basic geometry to measure them.

Academic Standards

A1 Recognize, classify, and use real numbers and their properties.
A2 Recognize, create, extend, and apply patterns, relations, and functions and their applications.
A3 Simplify algebraic expressions, solve and graph equations, inequalities and systems in one and two variables.
A5 Utilize various formulas in problem-solving situations.
E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T6 Technology problem-solving and decision-making tools

Suggested References

Barrows, R., & Jone, B. (2002). *Fundamentals of math with career applications*. Upper Saddle River, NJ: Pearson Prentice Hall.

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National Center for Construction Education and Research. (2001). *Welding level II.* Upper Saddle River, NJ: Pearson Prentice Hall.

Welding I
Unit 4: Introduction to Blueprints (Welding Symbols) (25 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Read, analyze, and design a blueprint. a. Identify terms, views, lines, and symbols commonly used on blueprints. b. Interpret a plan to determine layout. c. Interpret welding drawings. d. Describe the information in a title block. e. Explain the architect's and engineer's scales. f. Design a blueprint.	**Teaching:** • Using a blueprint (may use AutoCAD if available), explain all terms, symbols, and abbreviations on the blueprint and how they are used to locate various elements. Give each student a copy of the symbols and abbreviations (Contren Core Text Introduction to Blueprints Unit). Discuss drawings, material list, blueprint components, and architect's and engineer's scales.[E3, E8] • Divide students into pairs and have them quiz each other on the terms and symbols. • Have each student interpret a plan, specifications, and drawings; match them to an actual picture of the area; and interpret the information to the class.[E2, E4, E9] • Have students work as a team to prepare a blueprint of an instructor given project to present to a client (Contren Core Text Introduction to Blueprints Unit). Have students type a letter or report to the client and prepare blueprints including symbols, specifications and drawings, equipment and materials, title block, lines, and scales for the client.[E1, E4, E5, E9] • Have students contact a welding supply store manager (may simulate a call) or review advertisements on the Internet to determine the procedure for purchase of the materials and the estimated cost. Have students include an estimated cost of materials in the information sent to the client in the activity above. [A1, A5, E9, E10] • To determine the accuracy of the blueprint, have students complete a project according to the blueprint specifications (Contren Core Text Introduction to Blueprints Unit).[A1, A5, E10]

	Assessment: • Monitor group work as students quiz each other, and use a checksheet of symbols to monitor student success (Contren Core Text Introduction to Blueprints Unit). • Determine if each student matches the plan to the correct picture, and evaluate his or her interpretation of the information to the class for accuracy, clarity, and presentation skills. • Review the blueprint for accuracy, and grade the letter or report for accuracy of content, grammar, and organization. • Evaluate the estimated cost of materials for cost effectiveness. • Evaluate the project according to a checklist or rubric from Contren Unit.

STANDARDS

Contren Learning Series Best Practices

BLU1	Recognize and identify basic blueprint terms, components, and symbols.
BLU2	Relate information on blueprints to actual locations on the print.
BLU3	Recognize different classifications of drawings.
BLU4	Interpret and use drawing dimensions.
WSS1	Identify and explain the various parts of a welding symbol.
WSS2	Identify and explain fillet and groove weld symbols.
WSS3	Read welding symbols on drawings, specifications, and welding procedure specifications.
WSS4	Interpret welding symbols from a print.
WSS5	Draw welding symbols based on the observation of actual welds.
WDD1	Identify and explain a welding detail drawing.
WDD2	Identify and explain lines, material fills, and sections.
WDD3	Identify and explain object views.
WDD4	Identify and explain dimensioning.
WDD5	Identify and explain notes and bill of materials.
WDD6	Interpret basic elements of a welding detail drawing.
WDD7	Develop basic welding drawings.

Academic Standards

A1	Recognize, classify, and use real numbers and their properties.
A5	Utilize various formulas in problem-solving situations.

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze and evaluate literature from various genres and other written materials.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

Suggested References

Althouse, A., Turnquist, C., Bowditch, W., Bowditch, K., & Bowditch, M. (2003). *Modern welding*. Tinley Park, IL: Goodheart-Willcox.

Cary, H. (2002). *Modern welding technology* (5th ed.). Upper Saddle River, NJ: Prentice Hall.

Jeffus, L. (1997). *Welding principles and application* (4th ed.). Clifton Park, NY: Thompson Delmar Learning.

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National Center for Construction Education and Research. (2001). *Welding level I.* Upper Saddle River, NJ: Pearson Prentice Hall.

National Center for Construction Education and Research. (2001). *Welding level II.* Upper Saddle River, NJ: Pearson Prentice Hall.

Welding I
Unit 5: Hand and Power Tools **(10 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Demonstrate the use and maintenance of hand and power tools. a. Identify and discuss the use of common hand and power tools. b. Discuss rules of safety. c. Select and demonstrate the use of tools. d. Explain the procedures for maintenance.	**Teaching:** • Identify basic hand and power tools (e.g., hammer, screwdriver, saw, wrench, pliers, drill) used in the welding field (Contren Core Text Introduction to Hand Tools and Introduction to Power Tools Units and Level I Hand and Power Tools Unit) and how they have advanced through time.[E3, E8, H2] • Discuss safety factors, proper use, and maintenance.[E2, E5] • Describe accidents that can occur while using tools. • Divide students into groups and give each group a scenario or case study (written or on video) involving an accident. Have each group identify safety mistakes in each situation; determine correct procedures; and present the scenario, mistakes found, and procedures which should have been used to the class.[E2, E3, E4, E5, E9, E10] • Demonstrate the uses of various hand and power tools for the class. • Provide each student with a description of a project to be completed. Have the student select the appropriate tool for the project and demonstrate its proper use to the class.[E2, E3, E4, E5, E9, E10] • Assign each student a specific set of tools (i.e., hammers, power saws, wrenches, etc.). Have students use the Internet to research and write or type (if technology resources are available) a report on the proper procedures for maintenance of the assigned set of tools.[E1, E3, E4, E5, E9, E10] **Assessment:** • Have each student complete a test to identify specific tools. • Evaluate the case study presentation for content and delivery. • Evaluate the selection of the proper tool for

	the assigned project and demonstration of its use. • Evaluate the maintenance report for content, grammar, and organization.

STANDARDS

Contren Learning Series Best Practices

HTO1 Recognize and identify some of the basic hand tools used in the construction trade.
HTO2 Use these tools safely.
HTO3 Describe the basic procedures for taking care of these tools.
PTO1 Identify commonly used power tools of the construction trade.
PTO2 Use power tools safely.
PTO3 Explain how to maintain power tools properly.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.
H2 Describe the impact of science and technology on the historical development of the United States in the global community.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.

WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP5 Selects, applies, and maintains/troubleshoots technology.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

Suggested References

Althouse, A., Turnquist, C., Bowditch, W., Bowditch, K., & Bowditch, M. (2003). *Modern welding*. Tinley Park, IL: Goodheart-Willcox.

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National Center for Construction Education and Research. (2001). *Welding level II.* Upper Saddle River, NJ: Pearson Prentice Hall.

Welding I
Unit 6: Basic Rigging **(20 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Explain and identify safe rigging and equipment. a. Explain and practice safe rigging. b. Identify and explain rigging equipment. c. Inspect rigging equipment.	**Teaching:** • Using industry pictures of safe rigging from Contren Core Text Basic Rigging Unit, trade publications, and overheads of rigging equipment, identity, inspect, and explain the techniques of safe rigging.[E1] • Students will be given scale models of rigging equipment and will practice the rigging process. • Take students on a field trip to a local industry to observe rigging procedures. Students will be divided into groups, take pictures of rigging, and write or type an individual report describing their pictures and present their report to the class.[E1, E2, E5] **Assessment:** • Monitor the students as they quiz each other while working with the scale models. • The instructor will monitor the students at the field trip site and industry personnel will provide instruction on proper rigging techniques. • The written report, pictures, and presentation will be graded on content and delivery.
2. Discuss the proper use of load-handling and signaling practices. a. Discuss the proper procedures for estimating size, weight, and center of gravity. b. Simulate rigging and moving materials and equipment.	**Teaching:** • Discuss procedures for handling a load. Provide the proper hand signals for moving the load. Provide the correct procedures to move rig, materials, and equipment. Utilize activities in Contren Core Text Basic Rigging Unit.[A1, E3, E8] **Assessment:** • Assess the discussion using instructor observation to monitor the activity. • Assess the Contren activities from the materials provided.

STANDARDS

Contren Learning Series Best Practices

RIG1 Identify and describe the use of slings and common rigging hardware.
RIG2 Describe the basic inspection techniques and rejection criteria used for slings and hardware.
RIG3 Describe the basic hitch configurations and their proper connections.
RIG4 Describe basic load-handling safety practices.
RIG5 Demonstrate proper use of American National Standards Institute (ANSI) hand signals.

Academic Standards

A1 Recognize, classify, and use real numbers and their properties.
E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools

Secondary Welding Theory and Applications

T6 Technology problem-solving and decision-making tools

Suggested References

Althouse, A., Turnquist, C., Bowditch, W., Bowditch, K., & Bowditch, M. (2003). *Modern welding*. Tinley Park, IL: Goodheart-Willcox.

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National Center for Construction Education and Research. (2001). *Welding level II.* Upper Saddle River, NJ: Pearson Prentice Hall.

Welding I
Unit 7: Base Metal Preparation and Weld Quality (10 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Identify and explain the reasons for having regulations and codes for welding. a. Identify agencies that set regulations for welding codes. b. Describe the different tests given for weld certification. c. Analyze weld imperfections, their causes, and nondestructive and destructive examination practices. d. Discuss the importance of quality workmanship.	**Teaching:** • The instructor will explain the purpose and importance of having agency settings and regulating welding codes and the importance of quality workmanship. The student will submit a written report to discuss agency codes and regulating welding codes and the importance of quality workmanship.[E1, E9] • The instructor will show examples of different types of welding certification tests. A group of students will research welding certification tests using the Internet and will present to the class the findings.[E4, E5, E9] • The instructor will discuss and show examples of weld imperfections and their causes. Students will research weld imperfections.[E3, E4] • The instructor will demonstrate nondestructive and destructive examination procedures. The student will perform nondestructive and destructive examination procedures to welds. **Assessment:** • The written report will be graded for clarity and content. • The welding certification information will be printed, presented, and evaluated for content using a rubric. • A summary of the weld imperfection information will be evaluated for clarity and content. • Use a checklist to evaluate examination procedures.
2. Explore base metal cleaning and their properties. a. Describe mechanical and/or chemical cleaning of nonferrous and ferrous metals.	**Teaching:** • The instructor will discuss and demonstrate mechanical and/or chemical techniques to identify and clean ferrous and nonferrous metals. The student will perform the instructor-assigned task.

	Assessment: • A checklist will be used to evaluate cleaning and identification exercises.
3. Explore joint designs and their purpose. a. Identify and discuss joint designs. (butt joint, T-joint, plug joint, lap joint and corner joints)	**Teaching:** • The instructor will discuss joint designs and their purpose using handouts and a video. • Students in groups will be given various welding joint situations. The students will decide which design is best for the situation.[E4] **Assessment:** • Give a written test covering joint designs and their purpose. • The presentation on designs will be evaluated by the class for clarity and content.

STANDARDS

Contren Learning Series Best Practices

WBM1 Clean base metal for welding or cutting.
WBM2 Identify and explain joint design.
WBM3 Explain joint design considerations.
WBM4 Using a nibbler, cutter, or grinder, mechanically prepare the edge of a mild steel plate 1⁄4" to 3⁄4" thick at 22 1/2° (or 30° depending on equipment available).
WBM5 Using a nibbler, cutter, or grinder, mechanically prepare the end of a pipe with a 30° or 37 1⁄2° bevel (depending on equipment available) and a 3⁄32" land. Use 6", 8", or 10" Schedule 40 or Schedule 80 mild steel pipe.
WBM6 Select the proper joint design based on a welding procedure specification (WPS) or instructor direction.
WWQ1 Identify and explain codes governing welding.
WWQ2 Identify and explain weld imperfections and their causes.
WWQ3 Identify and explain nondestructive examination practices.
WWQ4 Identify and explain welder qualification tests.
WWQ5 Explain the importance of quality workmanship.
WWQ6 Identify common destructive testing methods.

Academic Standards

E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.

E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

Suggested References

Althouse, A., Turnquist, C., Bowditch, W., Bowditch, K., & Bowditch, M. (2003). *Modern welding*. Tinley Park, IL: Goodheart-Willcox.

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National Center for Construction Education and Research. (2001). *Welding level II.* Upper Saddle River, NJ: Pearson Prentice Hall.

Welding I
Unit 8: Oxy/Fuel Operations **(50 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
Note: The instructor has the option to choose Oxy/Fuel Cutting Welding. The instructor may choose to teach both.	**Teaching:** **Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.** • The instructor will present a video on a given task. The student will develop several questions and answers from the video. E1 • The instructor will demonstrate identification and interpretation of the specific task concerns. The student will utilize a variety of resources to write a report to identify and interpret task concern. E1, E2, E3, E5, E8, E9, E10 • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task. E4, E3, E5 • Actual pictures from the lab will be shown and discussed about the specific task. Students will perform each task assigned. **Assessment:** • The questions and answers will be evaluated for content and clarity. • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity. • A checklist will be used to evaluate the tasks.
1. Perform safety inspections and procedures for operation of Oxy/Fuel equipment and accessories.	**Teaching:** **The instructor will explain and demonstrate the following. The students will demonstrate the following before performing live work.** • Identify the terminology and parts of gas cutting equipment and accessories. • Identify safety ventilation required for use of industrial gases. • Assemble and disassemble, light and adjust and shut down an Oxy/Fuel unit with all safety equipment required.

	• Conduct a leak test of equipment using soapy water. **Assessment:** • A written test will be given for the terminology. • A checklist will be used to observe the students while they are performing safety inspections and procedures for operation.
2. Demonstrate cutting and/or welding procedures for mild steel with Oxy/Fuel equipment.	**Teaching:** **The instructor will explain and demonstrate the following. The students will demonstrate the following before performing live work.** • Light and adjust cutting torch. • Preheat metal to required temperature. • Make a 90-degree cut in mild steel. **Assessment:** • The students will be grouped. Each group will give a presentation of the skills learned. The audience will ask questions. The presentation checklist will be used to evaluate.
3. Operate a motorized, portable Oxy/Fuel cutting machine.	**Teaching:** **The instructor will explain and demonstrate the following. The students will demonstrate the following before performing live work.** • The instructor will explain and demonstrate how to operate the motorized, portable Oxy/Fuel cutting machine. Each student will simulate operating the machine. **Assessment:** • The instructor will assign a fabrication project to the student. The student will operate the portable Oxy/Fuel cutting machine. The student project will be critiqued by instructor using the finished project and according to project specifications.

STANDARDS

Contren Learning Series Best Practices

WOC1 Identify and explain the use of Oxy/Fuel cutting equipment.

Secondary Welding Theory and Applications

WOC2 Set up Oxy/Fuel equipment.
WOC3 Light and adjust an Oxy/Fuel torch.
WOC4 Shut down Oxy/Fuel cutting equipment.
WOC5 Disassemble Oxy/Fuel equipment.
WOC6 Change empty cylinders.
WOC7 Perform Oxy/Fuel cutting:
- Straight line and square shapes
- Piercing and slot cutting
- Bevels
- Washing
- Gouging

WOC8 Operate a motorized, portable Oxy/Fuel gas cutting machine.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

Suggested References

Althouse, A., Turnquist, C., Bowditch, W., Bowditch, K., & Bowditch, M. (2003). *Modern welding*. Tinley Park, IL: Goodheart-Willcox.

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National Center for Construction Education and Research. (2001). *Welding level I.* Upper Saddle River, NJ: Pearson Prentice Hall.

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Welding I
Unit 9: Shielded Metal Arc Welding (SMAW) (100 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Perform safety rules and inspections of equipment and accessories. 2. Identify types of welding machines and their accessories. a. Describe AC/DC welding equipment. b. Identify welding electrodes, their characteristics, and their applications. c. Describe welding positions, including flat, horizontal, vertical, and overhead.	**Teaching:** **Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.** • The instructor will present a video on the given task. The student will develop several questions and answers from the video. E1 • The instructor will demonstrate identification and interpretation of the specific task concerns. Students will utilize a variety of resources to write a report to identify and interpret task concerns. E1, E2, E3, E5, E8, E9, E10 • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task. E4, E3, E5 • Actual pictures from the lab will be shown and discussed about the specific task. Students will perform each task assigned. **Assessment:** • The questions and answers will be evaluated for content and clarity. • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity. • A checklist will be used to evaluate the tasks.
3. Demonstrate the ability to set up and perform welding operations on mild steel, according to established safety procedures.	**Teaching:** **The instructor will explain and demonstrate the following. The students will demonstrate the following before performing live work.** • Demonstrate procedures to strike an arc, form a puddle, and control puddle. • Build a pad on mild steel in flat position. • Perform fillet weld according to instructor specifications with mild steel electrodes. This is Contren Module 291-03, 04, 05, 06, and 07.

	Assessment: • A written test will be given for the terminology. • A checklist will be used to observe the students while they are performing safety inspections and procedures for operation.
4. Evaluate weld quality AWS and ASME.	**Teaching:** **The instructor will explain and demonstrate the following. The students will demonstrate the following before performing live work.** • The instructor will review the weld quality standards, specifications, codes governing welding, weld imperfections and their causes, non-destructive examination practices, welder qualification tests, quality workmanship, and typical site quality organizational structures for the students. • The instructor will perform weld inspection as the students finish a project. **Assessment:** • A written test will be given for the terminology. • Welds will be in accordance with Contren standards Module 29104-03. A checklist will be used.

STANDARDS

Contren Learning Series Best Practices

WSM1 Identify and explain shielded metal arc welding (SMAW) safety.
WSM2 Identify and explain welding electrical current.
WSM3 Identify and explain arc welding machines.
WSM4 Explain setting up arc welding equipment.
WSM5 Set up a machine for welding.
WSM6 Identify and explain tools for weld cleaning.
WSM7 Identify factors that affect electrode selection.
WSM8 Explain the American Welding Society (AWS) and the American Society of Mechanical Engineers (ASME) filler metal classification system.
WSM9 Identify different types of filler metals.
WSM10 Explain the storage and control of filler metals.
WSM11 Explain filler metal traceability requirements and how to use applicable code requirements.
WSM12 Identify and select the proper electrode for an identified welding task.
WSM13 Set up shielded metal arc welding (SMAW) equipment.

Secondary Welding Theory and Applications

WSM14 Describe methods of striking an arc.
WSM15 Properly strike and extinguish an arc.
WSM16 Describe causes of arc blow and wander.
WSM17 Make stringer, weave, and overlapping beads.
WSM18 Make fillet welds in the:
- Horizontal (2F) position
- Vertical (3F) position
- Overhead (4F) position

WSM19 Prepare shielded metal arc welding (SMAW) equipment for open-root V-groove welds.
WSM20 Perform open-root V-groove welds in the:
- Flat (1G) position
- Horizontal (2G) position

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

Secondary Welding Theory and Applications

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

Suggested References

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Welding II
Unit 1: Introduction, Orientation, and Employability Skills (15 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Describe local program and vocational center policies and procedures. a. Describe local program and vocational center policies and procedures including dress code, attendance, academic requirements, discipline, and transportation regulations.	**Teaching:** • Present local program and vocational center policies and procedures. • Students will read the handbook to become aware of what is expected of them in relation to the policies and procedures of the school. This will include dress code, attendance, academic requirements, discipline, and transportation regulations. Students will work together in pairs. A student with a higher reading ability will team up with a student with a lower reading ability to get a better understanding of the school's program policies and procedures.[E2, E3, E8] **Assessment:** • Students will have a test on applicable policies and procedures. • Students will submit a written report on rules and regulations. • Explanation of local student handbook requirements. • Students will complete exercises to identify equipment and functions found in the school lab. • Assess student orientation knowledge through instructor observations and written unit test. File completed test to document student mastery of the school and program policies and procedures.
2. Describe employment opportunities and responsibilities. a. Describe employment opportunities including potential earnings, employee benefits, job availability, place of employment, working conditions, and educational requirements. b. Describe basic employee responsibilities. c. Design a resume and complete a job application.	**Teaching:** • Use the Contren Series Core Text, Basic Employability Skills Unit and Welding Level I, Orientation to the Trade Unit to define trade terms related to basic employability skills. Discuss the chapter and perform the related activities to promote awareness of employability skills.[E2] • The instructor will explain the contents of a cover letter and resume. Examples of cover

	letters and resumes will be given to the students. The student will design a cover letter and resume. • The instructor will discuss a job application. The student will obtain and complete a job application from a local business. • Students will use career software, such as Choices, to measure their aptitudes and abilities for particular careers.[E3, E8] • Students will use the Internet to research a list of careers for which they will be qualified upon program completion.[E2, E3, E4, E5, E10] • Students will use available resources (college catalogs and college websites) to research information about postsecondary educational opportunities.[E2, E3, E4, E5, E10] • Students will select a career in the field and outline educational and skill requirements, expected job growth, and entry-level salaries.[E1, E3, E8, E9] **Assessment:** • Assessment will be determined by matching test for definitions and the level of success regarding the Contren activities. Lessons involving writing and math skill will be integrated with the appropriate department. • Monitor students as they plan the ceremony and select competitive events. Use a checklist to evaluate the report. • Use a checklist to evaluate the campaign speech and poster. • Use a checklist to evaluate the resume and cover letter. • A rubric will be used to evaluate the job application. • Use a checklist to evaluate the presentation. • Review career software printout to assess student aptitudes and abilities.

3. Explore leadership skills and personal development opportunities provided students by student organizations to include SkillsUSA. a. Demonstrate effective teambuilding and leadership skills. b. Practice appropriate work ethics.	**Teaching:** • Discuss the role of a team member and a leader. Assign the students roles within a team and have them role play a situation in which there is a conflict which must be resolved. Utilize the lessons from SkillsUSA, Contren Tools for Success, or other resources to provide additional training.[E3, E8] • Discuss appropriate work ethics standards. Have the students list what they believe to be the most common problems within the welding profession. **Assessment:** • Assess the role play using a checklist for documentation. • Lessons from other resources should be assessed according to the recommended resource guide.
4. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations.	**Teaching:** • Have the students perform an activity involving verbal instructions. Divide the students into groups and have one team be the customer and the other be the contractor. The customer will describe the project and the contractor will have to provide a brief plan for the construction of the project. Have the groups switch roles and the customer will provide the contractor with a written plan and blueprint. The contractor will describe the procedure for construction of the project.[E2, E3, E4, E8] **Assessment:** • The lesson will be assessed using a presentation rubric and a checklist for the written projects.
5. Discuss the history of welding to include materials, terminology, and techniques.	**Teaching:** • Utilize the Contren Welding Level I Orientation to the Trade Unit to discuss the history of welding. Have the students research the history of welding and develop a short presentation on each topic. The students will present to the class.[H1, H2]

	Assessment: • Assess the presentation using a presentation checklist.

STANDARDS

Contren Learning Series Best Practices

SAF1 Identify the responsibilities and personal characteristics of a professional craftsperson.
SAF2 Explain the role that safety plays in the construction crafts.
SAF3 Describe what job-site safety means.
SAF4 Explain the appropriate safety precautions around common job-site hazards.
SAF5 Demonstrate the use and care of appropriate personal protective equipment.
SAF5 Follow safe procedures for lifting heavy objects.
SAF6 Describe safe behavior on and around ladders and scaffolds.
SAF7 Explain the importance of the HazCom (Hazard Communication Standard) requirement and MSDS (Material Safety Data Sheets).
SAF8 Describe fire prevention and fire fighting techniques.
SAF9 Define safe work procedures around electrical hazards.
COM1 Demonstrate the ability to understand information and instructions that are presented in both written and verbal form.
COM2 Demonstrate the ability to communicate effectively in on-the-job situations using written and verbal skills.
EMP1 Explain the construction industry, the role of the companies that make up the industry, and the role of individual professionals in the industry.
EMP2 Demonstrate critical thinking skills and the ability to solve problems using those skills.
EMP3 Demonstrate knowledge of computer systems and explain common uses for computers in the construction industry.
EMP4 Demonstrate effective relationship skills with teammates and supervisors, exhibit the ability to work on a team, and demonstrate appropriate leadership skills.
EMP5 Be aware of workplace issues such as sexual harassment, stress, and substance abuse.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.

E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.
H1 Explain how geography, economics, and politics have influenced the historical development of the United States in the global community.
H2 Describe the impact of science and technology on the historical development of the United States in the global community.
H3 Describe the relationship of people, places, and environments through time.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

Suggested References

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Welding II
Unit 2: Basic Safety (Review) **(10 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Describe general safety rules for working in a shop/lab and industry. a. Describe how to avoid on-site accidents. b. Explain the relationship between housekeeping and safety. c. Explain the importance of following all safety rules and company safety policies. d. Explain the importance of reporting all on-the-job injuries, accidents, and near misses. e. Explain the need for evacuation policies and the importance of following them. f. Explain the employer's substances abuse policy and how it relates to safety. g. Explain the safety procedures when working near pressurized or high temperature.	**Teaching:** **This can be used for the entire unit.** • Identify, discuss, and demonstrate terms, rules, and procedures related to shop/lab and industry safety (Contren Core Text Basic Safety Unit and Level I Orientation to The Trade Unit).[E3, E8] • Required written tests will follow each section of guidelines for safety rules and procedures. • Provide the students with a list of terms and have them define the terms. Pair the students to quiz each other on the definitions in preparation for a written exam.[E2, E3, E4, E8] • Use the guidelines provided for personal safety (i.e., clothing, jewelry, hair, eyes, and ears). Divide the students into pairs and assign each pair one of the guidelines. Each pair will demonstrate the "do's and don'ts" of the guideline.
2. Identify and apply safety around welding operations. a. Use proper safety practices when welding or working around welding operations. b. Use proper safety practices when welding in or near trenches and excavations. c. Explain the term *proximity work*.	• Have an industry speaker present to the class on the necessity of safety in the work environment. The students will write a summary of the presentation.[E1, E2, E9]
3. Identify and explain use of various barriers and confinements. a. Explain the safety requirements for working in confined areas. b. Explain and practice lockout/tagout procedures. c. Explain the different barriers and barricades and how they are used. d. Recognize and explain personal protective equipment. e. Inspect and care for personal protective equipment.	• Divide the students into teams and have them develop scenarios of hazards and accidents using the Contren Series Core Text, Basic Safety Unit and Level I Orientation to the Trade Unit, trade publications, and the Internet. This will include tools, spills, working around welding, improper use of barriers, ladders or scaffolds, use of MSDS information, fires, and electrical situations. In a game type situation, one team will read a scenario and the other teams will compete to be the first to provide the proper safety measures which should have been used to prevent the hazardous situation or accident. Points will be awarded to the teams with the correct answers.[E2, E4]

4. Explain lifting and the use of ladders and scaffolds. a. Identify and explain the procedures for lifting heavy objects. b. Inspect and safely work with various ladders and scaffolds.	• Required written tests will follow each section of guidelines for safety rules and procedures. • NOTE: SAFETY IS TO BE TAUGHT AS AN ONGOING PART OF THE COURSE THROUGHOUT THE YEAR. **Assessment:** • Student participation will be monitored by the instructor and the written exam will be graded. The student must achieve 100% accuracy. • The do's and don'ts exercise will be critiqued with a peer review. • The summary of the speaker's presentation will be critiqued using a rubric. • The teams will be rewarded according the points earned from the game. This could be extra points, classroom privileges, etc. • Written exams will be graded.
5. Explain the Material Safety Data Sheet (MSDS). a. Explain the function of the MSDS. b. Interpret the requirements of the MSDS.	
6. Explain fires. a. Explain the process by which fires start. b. Explain fire prevention of various flammable liquids. c. Explain the classes of fire and the types of extinguishers.	
7. Explain safety in and around electrical situations. a. Explain injuries when electrical contact occurs. b. Explain safety around electrical hazards. c. Explain action to take when an electrical shock occurs.	

STANDARDS

Contren Learning Series Best Practices

SAF1 Identify the responsibilities and personal characteristics of a professional craftsperson.
SAF2 Explain the role that safety plays in the construction crafts.
SAF3 Describe what job-site safety means.
SAF4 Explain the appropriate safety precautions around common job-site hazards.
SAF5 Demonstrate the use and care of appropriate personal protective equipment.
SAF5 Follow safe procedures for lifting heavy objects.
SAF6 Describe safe behavior on and around ladders and scaffolds.
SAF7 Explain the importance of the HazCom (Hazard Communication Standard) requirement and MSDS (Material Safety Data Sheets).
SAF8 Describe fire prevention and fire fighting techniques.
SAF9 Define safe work procedures around electrical hazards.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.
management

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

Suggested References

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Welding II
Unit 3: Advanced Base Metal Preparation and Weld Quality (20 Hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Identify and explain the reasons for having regulations and codes for welding. a. Identify agencies that set regulations for welding codes. b. Describe different tests given for weld certification. c. Analyze weld imperfections, their causes, and nondestructive and destructive examination practices. d. Discuss the importance of quality workmanship.	**Teaching:** • The instructor will explain the purpose and importance of having agency settings and regulating welding codes and the importance of quality workmanship. The student will submit a written report to discuss agency codes and regulating welding codes and the importance of quality workmanship.[E1, E4, E5, E9] • The instructor will show examples of different types of welding certification tests. The student will research the welding certification tests using the Internet. The student will research welding certification and will present to the class the findings.[E3] • The instructor will discuss and show examples weld imperfections and their causes. Students will research weld imperfections.[E3] • The instructor will demonstrate nondestructive and destructive examination procedures. The student will perform nondestructive and destructive examination procedures to welds. **Assessment:** • The written report will be graded for clarity and content. • The welding certification information will be printed, presented, and evaluated for content using a rubric. • A summary of the weld imperfection information will be evaluated for clarity and content. • Use a checklist to evaluate examination procedures.
2. Explore base metal cleaning and their properties. a. Describe mechanical and/or chemical cleaning of nonferrous and ferrous metals.	**Teaching:** • The instructor will discuss and demonstrate mechanical and/or chemical techniques to identify and clean ferrous and nonferrous metals. The student will perform the instructor-assigned task.

	Assessment: • A checklist will be used to evaluate cleaning and identification exercises.
3. Explore joint designs and their purpose. a. Identify and discuss joint designs (butt joint, T-joint, plug joint, lap joint, and corner joints).	**Teaching:** • The instructor will discuss joint designs and their purpose using handouts and a video. • Students in groups will be given various welding joint situations. The students will decide which design is best for the situation and give a presentation. **Assessment:** • A written test will be given covering joint designs and their purpose. • The presentation on designs will be evaluated by the class for clarity and content.

STANDARDS

Contren Learning Series Best Practices

WBM1 Clean base metal for welding or cutting.
WBM2 Identify and explain joint design.
WBM3 Explain joint design considerations.
WBM4 Using a nibbler, cutter, or grinder, mechanically prepare the edge of a mild steel plate 1⁄4" to 3⁄4" thick at 22 1⁄2° (or 30° depending on equipment available).
WBM5 Using a nibbler, cutter, or grinder, mechanically prepare the end of a pipe with a 30° or 37 1⁄2° bevel (depending on equipment available) and a 3⁄32" land. Use 6", 8", or 10" Schedule 40 or Schedule 80 mild steel pipe.
WBM6 Select the proper joint design based on a welding procedure specification (WPS) or instructor direction.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.

E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

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T3 Technology productivity tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

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Welding II
Unit 4: Advanced Shielded Metal Arc Welding (SMAW) (110 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Review safety rules and perform safety inspections of equipment and accessories. 2. Review types of welding machines, electrodes, welding positions, and their accessories.	**Teaching:** **Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.** • The instructor will present a video on the given task. The student will develop several questions and answers from the video. [E1] • The instructor will demonstrate identification and interpretation of the specific task concerns. The student will utilize a variety of resources to write a report to identify and interpret task concern. [E1, E2, E3, E5, E8, E9, E10] • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task. [E4, E3, E5] • Actual pictures from the lab will be shown and discussed about the specific task. The students will perform each task assigned. **Assessment:** • The questions and answers will be evaluated for content and clarity. • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity. • A checklist will be used to evaluate the task.
3. Review and demonstrate the ability to set up and perform welding operations on mild steel, according to established safety procedures.	**Teaching:** **The instructor will explain and demonstrate the following. The students will demonstrate the following before performing live work.** • Demonstrate procedures to strike an arc, form a puddle, and control puddle. • Build a pad on mild steel in flat position. • Perform fillet weld according to instructor specifications with mild steel electrodes. This is Contren Modules 291-03, 04, 05, 06, and 07.

	Assessment: • A written test will be given for the terminology. • A checklist will be used to observe the students while they are performing safety inspections and procedures for operation.
4. Explain and demonstrate the following: a. Groove welds with backing in 1G, 2G, 3G, and 4G. b. Open V-groove welds in 1G and 2G.	**Teaching:** **The Instructor will explain and demonstrate the following. The students will demonstrate the following before performing live work.** • A handout will be given covering each weld and the position. • A video will be shown covering the welds and positions. • Students will demonstrate for the class various welds and positions. • The students will perform the welds and positions as assigned by the instructor. **Assessment:** • A written test will be given for the video and terminology. • A checklist will be used to observe the students while they are performing the welds and positions.

STANDARDS

Contren Learning Series Best Practices

WSM1 Identify and explain shielded metal arc welding (SMAW) safety.
WSM2 Identify and explain welding electrical current.
WSM3 Identify and explain arc welding machines.
WSM4 Explain setting up arc welding equipment.
WSM5 Set up a machine for welding.
WSM6 Identify and explain tools for weld cleaning.
WSM7 Identify factors that affect electrode selection.
WSM8 Explain the American Welding Society (AWS) and the American Society of Mechanical Engineers (ASME) filler metal classification system.
WSM9 Identify different types of filler metals.
WSM10 Explain the storage and control of filler metals.
WSM11 Explain filler metal traceability requirements and how to use applicable code requirements.
WSM12 Identify and select the proper electrode for an identified welding task.
WSM13 Set up shielded metal arc welding (SMAW) equipment.
WSM14 Describe methods of striking an arc.

Secondary Welding Theory and Applications

WSM15 Properly strike and extinguish an arc.
WSM16 Describe causes of arc blow and wander.
WSM17 Make stringer, weave, and overlapping beads.
WSM18 Make fillet welds in the:
- Horizontal (2F) position
- Vertical (3F) position
- Overhead (4F) position

WSM19 Prepare shielded metal arc welding (SMAW) equipment for open-root V-groove welds.
WSM20 Perform open-root V-groove welds in the:
- Flat (1G) position
- Horizontal (2G) position

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
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Welding II
Unit 5: Semi-Automatic Arc Welding (GMAW/FCAW) (60 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Identify safety rules and perform safety inspections of GMAW and FCAW equipment and accessories. 2. Identify and discuss types of GMAW and FCAW welding machines, equipment, and their accessories.	**Teaching:** **Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.** • The instructor will present a video on the given task. The student will develop several questions and answers from the video. E1 • The instructor will demonstrate identification and interpretation of the specific task concerns. The student will utilize a variety of resources to write a report to identify and interpret task concerns. E1, E2, E3, E5, E8, E9, E10 • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task. E4, E3, E5 • Actual pictures from the lab will be shown and discussed about the specific task. The students will perform each task assigned. **Assessment:** • The questions and answers will be evaluated for content and clarity. • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity. • A checklist will be used to evaluate the tasks.
3. Demonstrate the ability to set up and perform GMAW/FCAW welding operations. Apply safety practices and welding procedures, and perform multiple pass fillet welds and V-groove (open-root and/or backing) welds on mild steel and/or other materials.	**Teaching:** **The instructor will explain and demonstrate the following. The students will demonstrate the following before performing live work.** • Perform GMAW/FCAW multiple-pass fillet welds on the plate, using solid or composite wire and shielding gas in multiple positions. • Perform GMAW/FCAW multiple-pass (open-root and/or backing) V-groove welds on plate, using solid or composite wire and

	shielding gas, in multiple positions. **Assessment:** • A checklist will be used to observe the students while they are performing the various welds in the various positions. A checklist will be used for evaluation.

STANDARDS

Contren Learning Series Best Practices

WGF1 Explain gas metal arc welding (GMAW) and flux cored arc welding (FCAW) safety.
WGF2 Explain the characteristics of welding current and power sources.
WGF3 Identify and explain the use of GMAW and FCAW equipment:
- Spray transfer
- Globular
- Short circuiting
- Pulse

WGF4 Identify and explain the use of GMAW and FCAW shielding gases and filler metals.
WGF5 Set up GMAW and FCAW equipment and identify tools for weld cleaning.

(Open-root and/or backing V-groove Welds)

WGF6 Perform GMAW multiple-pass welds on plate, using solid or composite wire and shielding gas in multiple positions.
WGF7 Perform GMAW multiple-pass welds on plate, using solid or composite wire and shielding gas, in multiple positions.
WGF8 Perform FCAW multiple-pass welds on plate in multiple positions using flux cored wire and, if required, shielding gas.
WGF9 Perform FCAW multiple-pass welds on plate in multiple positions using flux cored wire and, if required, shielding gas.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.

E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP5 Selects, applies, and maintains/troubleshoots technology.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

Suggested References

Althouse, A., Turnquist, C., Bowditch, W., Bowditch, K., & Bowditch, M. (2003). *Modern welding*. Tinley Park, IL: Goodheart-Willcox.

Cary, H. (2002). *Modern welding technology* (5th ed.). Upper Saddle River, NJ: Prentice Hall.

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Welding II
Unit 6: Gas Tungsten Arc Welding (GTAW) (40 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Review safety rules and perform safety inspections of equipment and accessories. 2. Identify types of GTAW welding machines, gases, filler rods, and their accessories.	**Teaching:** **Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.** • The instructor will present a video on the given task. The student will develop several questions and answers from the video. [E1] • The instructor will demonstrate identification and interpretation of the specific task concerns. The student will utilize a variety of resources to write a report to identify and interpret task concerns. [E1, E2, E3, E5, E8, E9, E10] • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task. [E4, E3, E5] • Actual pictures from the lab will be shown and discussed about the specific task. The students will perform each task assigned. **Assessment:** • The questions and answers will be evaluated for content and clarity. • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity. • A checklist will be used to evaluate the tasks.
3. Demonstrate the ability to set up and perform welding operations on mild steel, according to established safety procedures.	**Teaching:** **The instructor will explain and demonstrate the following. The students will demonstrate the following before performing live work.** • Perform GTAW welds on the plate, using solid or composite wire and shielding gas in multiple positions. • Perform GTAW multiple-pass (open-root and/or backing) V-groove welds on plate, using solid or composite wire and shielding gas, in multiple positions.

	Assessment: A checklist will be used to observe the students while they are performing the various welds in the various positions, A checklist will be used for evaluation.

STANDARDS

Contren Learning Series Best Practices

WGT1 Explain gas tungsten arc welding (GTAW) safety.
WGT2 Identify and explain the use of GTAW equipment.
WGT3 Identify and explain the use of GTAW filler metals.
WGT4 Identify and explain the use of GTAW shielding gases.
WGT5 Set up GTAW equipment.

GTAW (Open-root V-groove and/or Fillet Welds in the 1F, 2F, 3F, and 4F positions)

WGT6 Build a pad in the flat position with stringer beads using GTAW and carbon steel filler metal.
WGT7 Make multiple-pass welds on carbon steel plate in the 1G and/or 1F position using GTAW and carbon steel filler metal.
WGT8 Make multiple-pass welds on carbon steel plate in the 2G and/or 2F position using GTAW and carbon steel filler metal.
WGT9 Make multiple-pass welds on carbon steel plate in the 3G and/or 3F position using GTAW and carbon steel filler metal.
WGT10 Make multiple-pass welds on carbon steel plate in the 4G and/or 4F position using GTAW and carbon steel filler metal.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.

E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

Suggested References

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Welding II
Unit 7: Carbon Arc Cutting Principles and Practices (10 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Set up and explain the principles, applications, electrode positioning, and equipment of air carbon arc cutting (CAC-A). a. Demonstrate the CAC-A process of washing and/or gouging.	**Teaching:** **Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.** • The instructor will present a video on the given task. The student will develop several questions and answers from the video. E1 • The instructor will demonstrate identification and interpretation of the specific task concerns. The student will utilize a variety of resources to write a report to identify and interpret task concerns. E1, E2, E3, E5, E8, E9, E10 • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task. E4, E3, E5 • Actual pictures from the lab will be shown and discussed about the specific task. The students will perform each task assigned. **The instructor will explain and demonstrate the following. The students will demonstrate the following before performing live work.** • Perform CAC–A welds in multiple positions. • Perform CAC–A in multiple positions. **Assessment:** • The questions and answers will be evaluated for content and clarity. • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity. • A checklist will be used to evaluate the tasks. • A checklist will be used to observe the students while they are performing the various welds in the various positions. A checklist will be used for evaluation.

STANDARDS

Contren Learning Series Best Practices

WAC1 Identify and explain the air carbon arc cutting (CAC-A) process and equipment.
WAC2 Select and install CAC-A electrodes.
WAC3 Prepare the work area and CAC-A equipment for safe operation.
WAC4 Use CAC-A equipment for washing and/or gouging activities.
WAC5 Perform storage and housekeeping activities for CAC-A equipment.
WAC6 Make minor repairs to CAC-A equipment.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

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National Center for Construction Education and Research. (2001). *Welding level II.* Upper Saddle River, NJ: Pearson Prentice Hall.

Welding II
Unit 8: Plasma Arc Cutting **(10 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Explain, set up, and safely perform plasma arc cutting (PAC).	**Teaching:** **Note: These strategies can be used for the entire unit. Safety will be reviewed and reinforced before and during the unit.** • The instructor will present a video on the given task. The student will develop several questions and answers from the video. E1 • The instructor will demonstrate identification and interpretation of the specific task concerns. The student will utilize a variety of resources to write a report to identify and interpret task concerns. E1, E2, E3, E5, E8, E9, E10 • Divide the students into groups and assign each group a specific task. Have each group construct a poster listing components and the diagram of the task. E4, E3, E5 • Actual pictures from the lab will be shown and discussed about the specific task. The students will perform each task assigned. **The instructor will explain and demonstrate the following. The students will demonstrate the following before performing live work.** • Perform PAC welds in multiple positions. • Perform PAC in multiple positions. **Assessment:** • The questions and answers will be evaluated for content and clarity. • A report will be presented to the class. A rubric will be used to evaluate the presentation. • Evaluate the poster for content and clarity. • A checklist will be used to evaluate the tasks. • A checklist will be used to observe the students while they are performing the various welds in the various positions. A checklist will be used for evaluation.

STANDARDS

Contren Learning Series Best Practices

WPC1 Identify and understand plasma arc cutting processes.
WPC2 Identify plasma arc cutting equipment.
WPC3 Prepare and set up plasma arc cutting equipment.
WPC4 Use plasma arc cutting equipment to make various types of cuts.
WPC5 Properly store equipment and clean the work area after use.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.

Workplace Skills for the 21st Century

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

National Educational Technology Standards for Students

T1 Basic operations and concepts
T3 Technology productivity tools
T4 Technology communications tools
T5 Technology research tools
T6 Technology problem-solving and decision-making tools

Suggested References

Althouse, A., Turnquist, C., Bowditch, W., Bowditch, K., & Bowditch, M. (2003). *Modern welding*. Tinley Park, IL: Goodheart-Willcox.

Cary, H. (2002). *Modern welding technology* (5th ed.). Upper Saddle River, NJ: Prentice Hall.

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National Center for Construction Education and Research. (2001). *Welding level I.* Upper Saddle River, NJ: Pearson Prentice Hall.

National Center for Construction Education and Research. (2001). *Welding level II.* Upper Saddle River, NJ: Pearson Prentice Hall.

Recommended Tools and Equipment

CAPITALIZED ITEMS
** (Quantities for 20 students multiplied by the number of classes)

1. Bandsaw, portable with accessories (2)
2. Bench, work or steel topped layout (2)
3. Bits, Drill 1/16 inch—1 inch (1)
4. Compressed air supply and accessories (min. 80 psi @ 8 cfm/station) (1)
5. Student computer with operating software with multimedia kit (1)
6. Instructor computer w/operating software with multimedia kit (1)
7. Crane (A-frame) or cart (1)
8. Cut off saw, 18 inch (1)
9. Cutter, plasma arc (PAC) (1)
10. Gas metal arc (GMAW/FCAW) (spray and short circuit) (6)
11. Grinder, pedestal (2)
12. Helmet, welding (20)**
13. Hoist, chain 5-ton (1)
14. Ironworker with accessories (1)
15. Jacket, cape, sleeves, or apron (leather) (20)**
16. Ornamental bender with accessories (1)
17. Oven, electrode (1)
18. Oxy/Fuel set, manual gas cutting (5)
19. Oxy/Fuel set, machine gas cutting (1)
20. Press, drill magnetic base 3/4 drive (1)
21. Press, hydraulic (1)
22. Press, drill ¾ inch drive (1)
23. Saw, band (1)
24. Shear, 1/4 inch capacity (1)
25. Station, eye wash (1)
26. Table, Oxy/Fuel burning with dross pan and replaceable slats (4 foot x 8 foot x 31inch) (2)
27. Table, Oxy/Fuel welding, double-sided (2)
28. Ventilation system (1)
29. Vise, bench, medium duty (4)
30. Welder, shielded metal arc (SMAW) (20)**
31. Welder, gas tungsten arc (GTAW) (6)
32. Welder (GMAW/FCAW) (6)

NON-CAPITALIZED ITEMS
** (Quantities for 20 students multiplied by the number of classes)

1. Burning, Oxy/Fuel tips, various sizes (10)
2. Brush, carbon steel wire (20)**
3. Brush, stainless steel wire (20)**
4. Cabinet, eye safety, sanitizing (1)

5. Com-a-long 1 1/2 ton (1)
6. Safety glasses (20)**
7. Chisel set, cold (2)
8. Clamps, C 8-inch (4)
9. Cleaners, Oxy/Fuel tip (12)
10. Drill, 1/2-inch electric hand (1)
11. Drill, 3/8-inch electric hand (1)
12. Cutter, air carbon arc (CAC-A) (1)
13. Dividers (radius maker, minimum 6-inch) (15)
14. Extinguisher, fire (3)
15. File, 10-inch mill, half round-bastard cut (5)**
16. Flashlight (2)
17. Flints, Oxy/Fuel friction (12)**
18. Gloves, welders (pair) (20)**
19. Goggles, burning or face shield (OFC & PAC) (20)**
20. Grinder, 7–9-inch right angle (4)
21. Grinder, 4–5-inch right angle (4)
22. Hammer, chipping (20)**
23. Hammer, 16 oz. ball peen (3)
24. Kit, first-aid (1)
25. Level, magnetic torpedo (4)
26. Level, 2-foot level (4)
27. Lighter, Oxy/Fuel friction spark (12)
28. Pliers, 10-inch groove or slip joint (20)
29. Pliers, 6-inch side or diagonal cutting (5)
30. Pliers, 10-inch vise grip clamp (5)
31. Pliers, 6-inch needle nosed (5)
32. Pliers, MIG (6)
33. Pliers, 10-inch vise grip (5)
34. Portable welder 250 AMP with GMAW/FCAW capability and accessories (1)
35. Pry bars (2)
36. Punch, center (5)
37. Rule, 12-inch English/metric steel bench (20)**
38. Screwdriver set, Phillips head (3)
39. Screwdriver set, flathead (3)
40. Scribe, metal (5)
41. Square, combination set (15)
42. Square (18 by 24-feet), framing (15)
43. Square (4-foot), framing
44. Tape, 25-foot steel measure (10)
45. Tongs, welder (20)
46. Wrench set, combination (SAE) (1)
47. Wrench set, Allen or hex to 3/8 inch (5)
48. Wrench, 12-inch adjustable (3)
49. Wrench set, combination (Metric) (1)

50. Wrench set, sockets with ratchets and pull handles (SAE 3/8-inch, 1/4-inch, and 1/2-inch drives) (2)
51. Wrench set, sockets with ratchets and pull handles (Metric 3/8-inch, 1/4-inch, and 1/2-inch (2)

RECOMMENDED INSTRUCTIONAL AIDS

It is recommended that instructors have access to the following items:

1. Calculator (1)
2. Cart, AV (for TV-VCR,DVD) (1)
3. TV-VCR-DVD(1)
4. Video out (Microcomputer to TV monitor) (1)

Student Competency Profile for Welding I

Student:_____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction and Orientation

_____1. Describe local program and vocational center policies and procedures.
_____2. Describe employment opportunities and responsibilities.
_____3. Explore leadership skills and personal development opportunities provided students by student organizations to include SkillsUSA..
_____4. Demonstrate the ability to follow verbal and written instructions and communicate effectively for the job situations.
_____5. Discuss the history of welding to include materials, terminology and techniques.

Unit 2: Basic Safety

_____1. Describe general safety rules for working in a shop/lab and industry.
_____2. Identify and apply safety around welding operations.
_____3. Identify and explain use of various barriers and confinements.
_____4. Explain lifting and the use of ladders and scaffolds.
_____5. Explain the Material Safety Data Sheets (MSDS).
_____6. Explain fires.
_____7. Explain safety in and around electrical situations.

Unit 3: Basic Math

_____1. Apply the four basic math skills with whole numbers, fractions, and percent.
_____2. Use the metric system
_____3. Apply basic mathematics for welding.

Unit 4: Introduction to Blueprints

_____1. Read, analyze, and design a blueprint.

Unit 5: Hand and Power Tools

_____1. Demonstrate the use and maintenance of hand and power tools.

Unit 6: Basic Rigging

_____1. Explain and identify safe rigging and equipment.
_____2. Discuss the proper use of load-handling and signaling practices.

Unit 7: Base Metal Preparation and Weld Quality

_____1. Identify and explain the reasons for having regulations and codes for welding.
_____2. Explore base metal cleaning and their properties.
_____3. Explore joint designs and their purpose.

Unit 8: Oxy/Fuel Operations

_____1. Perform safety inspections and procedures for operation of Oxy/Fuel equipment and accessories.
_____2. Demonstrate cutting and/or welding procedures for mild steel with Oxy/Fuel equipment.
_____3. Operate a motorized, portable Oxy/Fuel cutting machine.

Unit 9: Shielded Metal Arc Welding (SMAW)

_____1. Perform safety rules and inspections of equipment and accessories.
_____2. Identify types of welding machines and their accessories.
_____3. Demonstrate the ability to set up and perform welding operations on mild steel, according to established safety procedures.
_____4. Evaluate weld quality AWS and ASME.

Student Competency Profile for Welding II

Student:_____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Introduction, Orientation, and Employability Skills

_____1. Describe local program and vocational center policies and procedures.
_____2. Describe employment opportunities and responsibilities.
_____3. Explore leadership skills and personal development opportunities provided students by student organizations to include SkillsUSA.
_____4. Demonstrate the ability to follow verbal and written instructions and communicate effectively in on-the-job situations.
_____5. Discuss the history of welding to include materials, terminology, and techniques.

Unit 2: Basic Safety (Review)

_____1. Describe general safety rules for working in a shop/lab and industry.
_____2. Identify and apply safety around welding operations.
_____3. Identify and explain use of various barriers and confinements.
_____4. Explain lifting and the use of ladders and scaffolds.
_____5. Explain the Material Safety Data Sheet (MSDS).
_____6. Explain fires.
_____7. Explain safety in and around electrical situations.

Unit 3: Advanced Base Metal Preparation and Weld Quality

_____1. Identify and explain the reasons for having regulations and codes for welding.
_____2. Explore base metal cleaning and their properties.
_____3. Explore joint designs and their purpose.

Unit 4: Advanced Shielded Metal Arc Welding (SMAW)

_____1. Review safety rules and perform safety inspections of equipment and accessories.
_____2. Review types of welding machines, electrodes, welding positions, and their accessories.
_____3. Review and demonstrate the ability to set up and perform welding operations on mild steel, according to established safety procedures.
_____4. Explain and demonstrate specific groove welds.

Unit 5: Semi-Automatic Arc Welding (GMAW/FCAW)

_____1. Identify safety rules and perform safety inspections of GMAW and FCAW equipment and accessories.
_____2. Identify and discuss types of GMAW and FCAW welding machines, equipment, and their accessories.
_____3. Demonstrate the ability to set up and perform GMAW/FCAW welding operations.

Unit 6: Gas Tungsten Arc Welding (GTAW)

_____1. Review safety rules and perform safety inspections of equipment and accessories.
_____2. Identify types of GTAW welding machines, gases, filler rods, and their accessories.
_____3. Demonstrate the ability to set up and perform welding operations on mild steel, according to established safety procedures.

Unit 7: Carbon Arc Cutting Principles and Practices

_____1. Set up and explain the principles, applications, electrode positioning, and equipment of air carbon arc cutting (CAC-A).

Unit 8: Plasma Arc Cutting

_____1. Explain, set up, and safely perform plasma arc cutting (PAC).

Appendix A: Contren Learning Series Best Practices[1]

SAF1	Identify the responsibilities and personal characteristics of a professional craftsperson.
SAF2	Explain the role that safety plays in the construction crafts.
SAF3	Describe what job-site safety means.
SAF4	Explain the appropriate safety precautions around common job-site hazards.
SAF5	Demonstrate the use and care of appropriate personal protective equipment.
SAF5	Follow safe procedures for lifting heavy objects.
SAF6	Describe safe behavior on and around ladders and scaffolds.
SAF7	Explain the importance of the HazCom (Hazard Communication Standard) requirement and MSDS (Material Safety Data Sheets).
SAF8	Describe fire prevention and fire fighting techniques.
SAF9	Define safe work procedures around electrical hazards.
COM1	Demonstrate the ability to understand information and instructions that are presented in both written and verbal form.
WWS1	Identify some common hazards in welding.
WWS2	Explain and identify proper personal protection used in welding.
WWS3	Demonstrate how to avoid welding fumes.
WWS4	Explain some of the causes of accidents.
WWS5	Identify and explain uses for material safety data sheets.
WWS6	Demonstrate safety techniques for storing and handling cylinders.
WWS7	Explain how to avoid electric shock when welding.
WWS8	Demonstrate proper material handling methods.
MAT1	Add, subtract, multiply, and divide whole numbers, with and without a calculator.
MAT2	Use a standard ruler and a metric ruler to measure.
MAT3	Add, subtract, multiply, and divide fractions.
MAT4	Add, subtract, multiply, and divide decimals, with and without a calculator.
MAT5	Convert decimals to percents and percents to decimals.
MAT6	Convert fractions to decimals and decimals to fractions.
MAT7	Explain what the metric system is and how it is important in the construction trade.
MAT8	Recognize and use metric units of length, weight, volume, and temperature.
MAT9	Recognize some of the basic shapes used in the construction industry and apply basic geometry to measure them.
BLU1	Recognize and identify basic blueprint terms, components, and symbols.
BLU2	Relate information on blueprints to actual locations on the print.
BLU3	Recognize different classifications of drawings.
BLU4	Interpret and use drawing dimensions.
WSS1	Identify and explain the various parts of a welding symbol.
WSS2	Identify and explain fillet and groove weld symbols.
WSS3	Read welding symbols on drawings, specifications, and welding procedure specifications.
WSS4	Interpret welding symbols from a print.
WSS5	Draw welding symbols based on the observation of actual welds.
WDD1	Identify and explain a welding detail drawing.

[1] *Contren learning series.* Retrieved October 7, 2004, from http://www.nccer.org/

WDD2 Identify and explain lines, material fills, and sections.
WDD3 Identify and explain object views.
WDD4 Identify and explain dimensioning.
WDD5 Identify and explain notes and bill of materials.
WDD6 Interpret basic elements of a welding detail drawing.
WDD7 Develop basic welding drawings.
HTO1 Recognize and identify some of the basic hand tools used in the construction trade.
HTO2 Use these tools safely.
HTO3 Describe the basic procedures for taking care of these tools.
PTO1 Identify commonly used power tools of the construction trade.
PTO2 Use power tools safely.
PTO3 Explain how to maintain power tools properly.
RIG1 Identify and describe the use of slings and common rigging hardware.
RIG2 Describe the basic inspection techniques and rejection criteria used for slings and hardware.
RIG3 Describe the basic hitch configurations and their proper connections.
RIG4 Describe basic load-handling safety practices.
RIG5 Demonstrate proper use of American National Standards Institute (ANSI) hand signals.
WBM1 Clean base metal for welding or cutting.
WBM2 Identify and explain joint design.
WBM3 Explain joint design considerations.
WBM4 Using a nibbler, cutter, or grinder, mechanically prepare the edge of a mild steel plate 1⁄4" to 3⁄4" thick at 22 1/2° (or 30° depending on equipment available).
WBM5 Using a nibbler, cutter, or grinder, mechanically prepare the end of a pipe with a 30° or 37 1⁄2° bevel (depending on equipment available) and a 3⁄32" land. Use 6", 8", or 10" Schedule 40 or Schedule 80 mild steel pipe.
WBM6 Select the proper joint design based on a welding procedure specification (WPS) or instructor direction.
WWQ1 cutting equipment.
WOC5 Disassemble Oxy/Fuel equipment.
WOC6 Change empty cylinders.
WOC7 Perform Oxy/Fuel cutting:
- Straight line and square shapes
- Piercing Identify and explain codes governing welding.

WWQ2 Identify and explain weld imperfections and their causes.
WWQ3 Identify and explain nondestructive examination practices.
WWQ4 Identify and explain welder qualification tests.
WWQ5 Explain the importance of quality workmanship.
WWQ6 Identify common destructive testing methods.
WOC1 Identify and explain the use of Oxy/Fuel cutting equipment.
WOC2 Set up Oxy/Fuel equipment.
WOC3 Light and adjust an Oxy/Fuel torch.
WOC4 Shut down Oxy/Fuel and slot cutting
- Bevels
- Washing
- Gouging

WOC8 Operate a motorized, portable Oxy/Fuel gas cutting machine.
WSM1 Identify and explain shielded metal arc welding (SMAW) safety.
WSM2 Identify and explain welding electrical current.
WSM3 Identify and explain arc welding machines.
WSM4 Explain setting up arc welding equipment.
WSM5 Set up a machine for welding.
WSM6 Identify and explain tools for weld cleaning.
WSM7 Identify factors that affect electrode selection.
WSM8 Explain the American Welding Society (AWS) and the American Society of Mechanical Engineers (ASME) filler metal classification system.
WSM9 Identify different types of filler metals.
WSM10 Explain the storage and control of filler metals.
COM1 Demonstrate the ability to understand information and instructions that are presented in both written and verbal form.
COM2 Demonstrate the ability to communicate effectively in on-the-job situations using written and verbal skills.
EMP1 Explain the construction industry, the role of the companies that make up the industry, and the role of individual professionals in the industry.
EMP2 Demonstrate critical thinking skills and the ability to solve problems using those skills.
EMP3 Demonstrate knowledge of computer systems and explain common uses for computers in the construction industry.
EMP4 Demonstrate effective relationship skills with teammates and supervisors, exhibit the ability to work on a team, and demonstrate appropriate leadership skills.
EMP5 Be aware of workplace issues such as sexual harassment, stress, and substance abuse.
WSM1 Identify and explain shielded metal arc welding (SMAW) safety.
WSM2 Identify and explain welding electrical current.
WSM3 Identify and explain arc welding machines.
WSM4 Explain setting up arc welding equipment.
WSM5 Set up a machine for welding.
WSM6 Identify and explain tools for weld cleaning.
WSM7 Identify factors that affect electrode selection.
WSM8 Explain the American Welding Society (AWS) and the American Society of Mechanical Engineers (ASME) filler metal classification system.
WSM9 Identify different types of filler metals.
WSM10 Explain the storage and control of filler metals.
WSM11 Explain filler metal traceability requirements and how to use applicable code requirements.
WSM12 Identify and select the proper electrode for an identified welding task.
WSM13 Set up shielded metal arc welding (SMAW) equipment.
WSM14 Describe methods of striking an arc.
WSM15 Properly strike and extinguish an arc.
WSM16 Describe causes of arc blow and wander.
WSM17 Make stringer, weave, and overlapping beads.
WSM18 Make fillet welds in the:
- Horizontal (2F) position
- Vertical (3F) position

• Overhead (4F) position

WSM19 Prepare shielded metal arc welding (SMAW) equipment for open-root V-groove welds.

WSM20 Perform open-root V-groove welds in the:
- Flat (1G) position
- Horizontal (2G) position

WGF1 Explain gas metal arc welding (GMAW) and flux cored arc welding (FCAW) safety.

WGF2 Explain the characteristics of welding current and power sources.

WGF3 Identify and explain the use of GMAW and FCAW equipment:
- Spray transfer
- Globular
- Short circuiting
- Pulse

WGF4 Identify and explain the use of GMAW and FCAW shielding gases and filler metals.

WGF5 Set up GMAW and FCAW equipment and identify tools for weld cleaning.

(Open-root and/or backing V-groove Welds)

WGF6 Perform GMAW multiple-pass welds on plate, using solid or composite wire and shielding gas in multiple positions.

WGF7 Perform GMAW multiple-pass welds on plate, using solid or composite wire and shielding gas, in multiple positions.

WGF8 Perform FCAW multiple-pass welds on plate in multiple positions using flux cored wire and, if required, shielding gas.

WGF9 Perform FCAW multiple-pass welds on plate in multiple positions using flux cored wire and, if required, shielding gas.

WGT1 Explain gas tungsten arc welding (GTAW) safety.

WGT2 Identify and explain the use of GTAW equipment.

WGT3 Identify and explain the use of GTAW filler metals.

WGT4 Identify and explain the use of GTAW shielding gases.

WGT5 Set up GTAW equipment.

GTAW (Open-root V-groove and/or Fillet Welds in the 1F, 2F, 3F, and 4F positions)

WGT6 Build a pad in the flat position with stringer beads using GTAW and carbon steel filler metal.

WGT7 Make multiple-pass welds on carbon steel plate in the 1G and/or 1F position using GTAW and carbon steel filler metal.

WGT8 Make multiple-pass welds on carbon steel plate in the 2G and/or 2F position using GTAW and carbon steel filler metal.

WGT9 Make multiple-pass welds on carbon steel plate in the 3G and/or 3F position using GTAW and carbon steel filler metal.

WGT10 Make multiple-pass welds on carbon steel plate in the 4G and/or 4F position using GTAW and carbon steel filler metal.

WAC1 Identify and explain the air carbon arc cutting (CAC-A) process and equipment.

WAC2 Select and install CAC-A electrodes.

WAC3 Prepare the work area and CAC-A equipment for safe operation.

WAC4 Use CAC-A equipment for washing and/or gouging activities.

WAC5 Perform storage and housekeeping activities for CAC-A equipment.

WAC6 Make minor repairs to CAC-A equipment.
WPC1 Identify and understand plasma arc cutting processes.
WPC2 Identify plasma arc cutting equipment.
WPC3 Prepare and set up plasma arc cutting equipment.
WPC4 Use plasma arc cutting equipment to make various types of cuts.
WPC5 Properly store equipment and clean the work area after use.

Appendix B: Academic Standards

Algebra I[2]

Competencies and Suggested Objective(s)

A1 Recognize, classify, and use real numbers and their properties.
- a. Describe the real number system using a diagram to show the relationships of component sets of numbers that compose the set of real numbers.
- b. Model properties and equivalence relationships of real numbers.
- c. Demonstrate and apply properties of real numbers to algebraic expressions.
- d. Perform basic operations on square roots excluding rationalizing denominators.

A2 Recognize, create, extend, and apply patterns, relations, and functions and their applications.
- a. Analyze relationships between two variables, identify domain and range, and determine whether a relation is a function.
- b. Explain and illustrate how change in one variable may result in a change in another variable.
- c. Determine the rule that describes a pattern and determine the pattern given the rule.
- d. Apply patterns to graphs and use appropriate technology.

A3 Simplify algebraic expressions, solve and graph equations, inequalities and systems in one and two variables.
- a. Solve, check, and graph linear equations and inequalities in one variable, including rational coefficients.
- b. Graph and check linear equations and inequalities in two variables.
- c. Solve and graph absolute value equations and inequalities in one variable.
- d. Use algebraic and graphical methods to solve systems of linear equations and inequalities.
- e. Translate problem-solving situations into algebraic sentences and determine solutions.

A4 Explore and communicate the characteristics and operations of polynomials.
- a. Classify polynomials and determine the degree.
- b. Add, subtract, multiply, and divide polynomial expressions.
- c. Factor polynomials using algebraic methods and geometric models.
- d. Investigate and apply real-number solutions to quadratic equations algebraically and graphically.
- e. Use convincing arguments to justify unfactorable polynomials.
- f. Apply polynomial operations to problems involving perimeter and area.

A5 Utilize various formulas in problem-solving situations.
- a. Evaluate and apply formulas (e.g., circumference, perimeter, area, volume, Pythagorean Theorem, interest, distance, rate, and time).
- b. Reinforce formulas experimentally to verify solutions.
- c. Given a literal equation, solve for any variable of degree one.

[2] *Mississippi mathematics framework—Algebra I.* (2003). Retrieved September 10, 2003, from http://marcopolo.mde.k12.ms.us/frameworks/mathematics/ma_algebra_i.html

d. Using the appropriate formula, determine the length, midpoint, and slope of a segment in a coordinate plane.
e. Use formulas (e.g., point-slope and slope-intercept) to write equations of lines.

A6 Communicate using the language of algebra.
a. Recognize and demonstrate the appropriate use of terms, symbols, and notations.
b. Distinguish between linear and non-linear equations.
c. Translate between verbal expressions and algebraic expressions.
d. Apply the operations of addition, subtraction, and scalar multiplication to matrices.
e. Use scientific notation to solve problems.
f. Use appropriate algebraic language to justify solutions and processes used in solving problems.

A7 Interpret and apply slope as a rate of change.
a. Define slope as a rate of change using algebraic and geometric representations.
b. Interpret and apply slope as a rate of change in problem-solving situations.
c. Use ratio and proportion to solve problems including direct variation (y=kx).
d. Apply the concept of slope to parallel and perpendicular lines.

A8 Analyze data and apply concepts of probability.
a. Collect, organize, graph, and interpret data sets, draw conclusions, and make predictions from the analysis of data.
b. Define event and sample spaces and apply to simple probability problems.
c. Use counting techniques, permutations, and combinations to solve probability problems.

Biology I[3]

Competencies and Suggested Objective(s)

B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
a. Demonstrate the proper use and care for scientific equipment used in biology.
b. Observe and practice safe procedures in the classroom and laboratory.
c. Apply the components of scientific processes and methods in the classroom and laboratory investigations.
d. Communicate results of scientific investigations in oral, written, and graphic form.

B2 Investigate the biochemical basis of life.
a. Identify the characteristics of living things.
b. Describe and differentiate between covalent and ionic bonds using examples of each.
c. Describe the unique bonding and characteristics of water that makes it an essential component of living systems.
d. Classify solutions using the pH scale and relate the importance of pH to organism survival.

[3] *Mississippi science framework—Biology I.* (2003). Retrieved September 10, 2003, from http://marcopolo.mde.k12.ms.us/frameworks/science/sci_biology_I.html

e. Compare the structure, properties and functions of carbohydrates, lipids, proteins and nucleic acids in living organisms.
f. Explain how enzymes work and identify factors that can affect enzyme action.

B3 Investigate cell structures, functions, and methods of reproduction.
a. Differentiate between prokaryotic and eukaryotic cells.
b. Distinguish between plant and animal (eukaryotic) cell structures.
c. Identify and describe the structure and basic functions of the major eukaryotic organelles.
d. Describe the way in which cells are organized in multicellular organisms.
e. Relate cell membrane structure to its function in passive and active transport.
f. Describe the main events in the cell cycle and cell mitosis including differences in plant and animal cell divisions.
g. Relate the importance of meiosis to sexual reproduction and the maintenance of chromosome number.
h. Identify and distinguish among forms of asexual and sexual reproduction.

B4 Investigate the transfer of energy from the sun to living systems.
a. Describe the structure of ATP and its importance in life processes.
b. Examine, compare, and contrast the basic processes of photosynthesis and cellular respiration.
c. Compare and contrast aerobic and anaerobic respiration.

B5 Investigate the principles, mechanisms, and methodology of classical and molecular genetics.
a. Compare and contrast the molecular structures of DNA and RNA as they relate to replication, transcription, and translation.
b. Identify and illustrate how changes in DNA cause mutations and evaluate the significance of these changes.
c. Analyze the applications of DNA technology (forensics, medicine, agriculture).
d. Discuss the significant contributions of well-known scientists to the historical progression of classical and molecular genetics.
e. Apply genetic principles to solve simple inheritance problems including monohybrid crosses, sex linkage, multiple alleles, incomplete dominance, and codominance.
f. Examine inheritance patterns using current technology (gel electrophoresis, pedigrees, karyotypes).

B6 Investigate concepts of natural selection as they relate to diversity of life.
a. Analyze how organisms are classified into a hierarchy of groups and subgroups based on similarities and differences.
b. Identify characteristics of kingdoms including monerans, protists, fungi, plants and animals.
c. Differentiate among major divisions of the plant and animal kingdoms (vascular/non-vascular; vertebrate/invertebrate).
d. Compare the structures and functions of viruses and bacteria relating their impact on other living organisms.
e. Identify evidence of change in species using fossils, DNA sequences, anatomical and physiological similarities, and embryology.

f. Analyze the results of natural selection in speciation, diversity, adaptation, behavior and extinction.

B7 Investigate the interdependence and interactions that occur within an ecosystem.

a. Analyze the flow of energy and matter through various cycles including carbon, oxygen, nitrogen and water cycles.
b. Interpret interactions among organisms in an ecosystem (producer/consumer/decomposer, predator/prey, symbiotic relationships and competitive relationships).
c. Compare variations, tolerances, and adaptations of plants and animals in major biomes.
d. Investigate and explain the transfer of energy in an ecosystem including food chains, food webs, and food pyramids.
e. Examine long and short-term changes to the environment as a result of natural events and human actions.

English II[4]

Competencies and Suggested Objective(s)

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.

a. Produce individual and/or group compositions and/or projects to persuade, tell a story, describe, create an effect, explain or justify an action or event, inform, entertain, etc.
b. Produce writing typically used in the workplace such as social, business, and technical correspondence; explanation of procedures; status reports; research findings; narratives for graphs; justification of decisions, actions, or expenses; etc.
c. Write a response, reaction, interpretation, analysis, summary, etc., of literature, other reading matter, or orally presented material.
d. Revise to ensure effective introductions, details, wording, topic sentences, and conclusions.

E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.

a. Listen to determine the main idea and supporting details, to distinguish fact from opinion, and to determine a speaker's purpose or bias.
b. Speak with appropriate intonation, articulation, gestures, and facial expression.
c. Speak effectively to explain and justify ideas to peers, to inform, to summarize, to persuade, to entertain, to describe, etc.

E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.

a. Read, view, and listen to distinguish fact from opinions and to recognize persuasive and manipulative techniques.
b. Access both print and non-print sources to produce an I-Search paper, research paper, or project.

[4] *Mississippi language arts framework—English II*. (2003). Retrieved September 10, 2003, from http://marcopolo.mde.k12.ms.us/frameworks/language_arts/la_10.html

c. Use computers and audio-visual technology to access and organize information for purposes such as resumes, career search projects, and analytical writings, etc.
d. Use reference sources, indices, electronic card catalog, and appropriate research procedures to gather and synthesize information.

E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
a. Interact with peers to examine real world and literary issues and ideas.
b. Show growth in critical thinking, leadership skills, consensus building, and self-confidence by assuming a role in a group, negotiating compromise, and reflecting on individual or group work.

E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
a. Share, critique, and evaluate works in progress and completed works through a process approach.
b. Communicate effectively in a group to present completed projects and/or compositions.
c. Edit oral and written presentations to reflect correct grammar, usage, and mechanics.

E6 Explore cultural contributions to the history of the English language and its literature.
a. Explore a variety of works from various historical periods, geographical locations, and cultures, recognizing their influence on language and literature.
b. Identify instances of dialectal differences which create stereotypes, perceptions, and identities.
c. Recognize root words, prefixes, suffixes, and cognates.
d. Relate how vocabulary and spelling have changed over time.

E7 Discover the power and effect of language by reading and listening to selections from various literary genres.
a. Listen to and read aloud selected works to recognize and respond to the rhythm and power of language to convey a message.
b. Read aloud with fluency and expression.
c. Analyze the stylistic devices, such as alliteration, assonance, word order, rhyme, onomatopoeia, etc., that make a passage achieve a certain effect.
d. Demonstrate how the use of language can confuse or inform, repel or persuade, or inspire or enrage.
e. Analyze how grammatical structure or style helps to create a certain effect.

E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
a. Read and explore increasingly complete works, both classic and contemporary, for oral discussion and written analysis.
b. Read, discuss, and interpret literature to make connections to life.
c. Read from a variety of genres to understand how the literary elements contribute to the overall quality of the work.
d. Identify qualities in increasingly complex literature that have produced a lasting impact on society.

e. Read for enjoyment, appreciation, and comprehension of plot, style, vocabulary, etc.

E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
- a. Infuse the study of grammar and vocabulary into written and oral communication.
- b. Demonstrate, in the context of their own writing, proficient use of the conventions of standard English, including, but not limited to, the following: complete sentences, subject-verb agreement, plurals, spellings, homophones, possessives, verb forms, punctuation, capitalization, pronouns, pronoun-antecedent agreement, parallel structure, and dangling and misplaced modifiers.
- c. Give oral presentations to reinforce the use of standard English.
- d. Employ increasingly proficient editing skills to identify and solve problems in grammar, usage, and structure.

E10 Use language and critical thinking strategies to serve as tools for learning.
- a. Use language to facilitate continuous learning, to record observations, to clarify thought, to synthesize information, and to analyze and evaluate language.
- b. Interpret visual material orally and in writing.

U. S. History from 1877[5]

Competencies and Suggested Objective(s)

H1 Explain how geography, economics, and politics have influenced the historical development of the United States in the global community.
- a. Apply economic concepts and reasoning when evaluating historical and contemporary social developments and issues (e.g., gold standard, free coinage of silver, tariff issue, laissez faire, deficit spending, etc.).
- b. Explain the emergence of modern America from a domestic perspective (e.g., frontier experience, Industrial Revolution and organized labor, reform movements of Populism and Progressivism, Women's Movement, Civil Rights Movement, the New Deal, etc.).
- c. Explain the changing role of the United States in world affairs since 1877 through wars, conflicts, and foreign policy (e.g., Spanish-American War, Korean conflict, containment policy, etc.).
- d. Trace the expansion of the United States and its acquisition of territory from 1877 (e.g., expansionism and imperialism).

H2 Describe the impact of science and technology on the historical development of the United States in the global community.
- a. Analyze the impact of inventions on the United States (e.g., telephone, light bulb, etc.).
- b. Examine the continuing impact of the Industrial Revolution on the development of our nation (e.g., mass production, computer operations, etc.).
- c. Describe the effects of transportation and communication advances since 1877.

[5] *Mississippi social studies framework—U.S. History from 1877*. (2003). Retrieved September 10, 2003, from http://marcopolo.mde.k12.ms.us/frameworks/social_studies/ss_us_history.html

H3 Describe the relationship of people, places, and environments through time.
- a. Analyze human migration patterns since 1877 (e.g., rural to urban, the Great Migration, etc.).
- b. Analyze how changing human, physical, geographic characteristics can alter a regional landscape (e.g., urbanization, Dust Bowl, etc.).

H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).
- a. Interpret special purpose maps, primary/secondary sources, and political cartoons.
- b. Analyze technological information on graphs, charts, and timelines.
- c. Locate areas of international conflict (e.g., Caribbean, Southeast Asia, Europe, etc.).

H5 Analyze the contributions of Americans to the ongoing democratic process to include civic responsibilities.
- a. Examine various reform movements (e.g., Civil Rights, Women's Movement, etc.).
- b. Examine the government's role in various movements (e.g., arbitration, 26th Amendment, etc.).
- c. Examine the role of government in the preservation of citizens' rights (e.g., 19th Amendment, Civil Rights Act of 1964).
- d. Examine individuals' duties and responsibilities in a democratic society (e.g., voting, volunteerism, etc.).

Appendix C: Workplace Skills for the 21st Century[6]

WP1 Allocates resources (time, money, materials and facilities, and human resources).
WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.
WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.
WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.
WP5 Selects, applies, and maintains/troubleshoots technology.
WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.
WP7 Basic Skills: Employs basic academic skills including reading, writing, arithmetic and mathematics, speaking, and listening.
WP8 Personal Qualities: Practices work ethics related to individual responsibility, integrity, honesty, and personal management.

[6] *Secretary's commission on achieving necessary skills*. Retrieved July 13, 2004, from http://wdr.doleta.gov/SCANS/

Appendix D: National Educational Technology Standards for Students[7]

T1 Basic operations and concepts
- Students demonstrate a sound understanding of the nature and operation of technology systems.
- Students are proficient in the use of technology.

T2 Social, ethical, and human issues
- Students understand the ethical, cultural, and societal issues related to technology.
- Students practice responsible use of technology systems, information, and software.
- Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.

T3 Technology productivity tools
- Students use technology tools to enhance learning, increase productivity, and promote creativity.
- Students use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.

T4 Technology communications tools
- Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.
- Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.

T5 Technology research tools
- Students use technology to locate, evaluate, and collect information from a variety of sources.
- Students use technology tools to process data and report results.
- Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.

T6 Technology problem-solving and decision-making tools
- Students use technology resources for solving problems and making informed decisions.
- Students employ technology in the development of strategies for solving problems in the real world.

[7] *ISTE: National educational technology standards (NETS).* Retrieved July 13, 2004, from http://cnets.iste.org/