Syracuse City School District
Career and Technical Education Program
Welding Pathway
Summary Overview

Pathway Overview

The Welding program is designed to give students a solid foundation in the knowledge and technical skills that will prepare them for positions as entry-level welders or for advanced placement in post-secondary education. The program provides students with the skills of arc welding, resistance welding, brazing and soldering, as well as cutting, heat-treating and metallurgy. Students will also gain knowledge of electrical systems, power sources and different welding technologies, welding systems, print interpretation and measurement, as well as the use and interpretation of visual symbols related to welding. Students will have the opportunity to intern at many local businesses as well as work on customer projects and design. Students who excel in this course will have the opportunity to work toward their Level 1–Entry Welder Certification through the American Welding Society (AWS).

Calendar for Pathway

Level	Quarter	Units of Study

**100
9th Grade**
	1	• Overview
		  ○ Class Expectations and Policies
		  ○ Careers in Welding
		  ○ Safety in the Welding Shop
		• Foundations
		  ○ Welding and Cutting Processes
		  ○ Math for Welding
		  ○ Weld Joints and Positions
		• Plasma Arc Cutting

	2	• GMAW (MIG Welding) and FCAW
		  ○ Equipment and Supplies
		  ○ Equipment Assembly and Adjustment
		  ○ Flat Welding Position
		• Oxyfuel Gas Processes
		  ○ Oxyfuel Gas Cutting and Welding Equipment and Supplies
		  ○ Oxyfuel Gas Cutting and Welding Equipment Assembly and Adjustment
		• Oxyfuel Gas Cutting

	3	• SMAW (Stick Welding)
		  ○ Equipment and Supplies
		  ○ Equipment Assembly and Adjustment
		• Flat Welding Position

	4	• GTAW (TIG Welding)
		  ○ Equipment and Supplies
		  ○ Equipment Assembly and Adjustment
		  ○ Flat Welding Position
		• Welding in Industry
		  ○ Pipe and Tube Welding
		• Review
		• Final Exam

**200
10th Grade**
	1	• Overview
		  ○ Class Expectations and Policies
		  ○ Careers in Welding
		  ○ Safety in the Welding Shop
		• Foundations
		  ○ Welding and Cutting Processes
		  ○ Physics of Welding
		  ○ Math for Welding
		  ○ Math Applications for Welders
		  ○ Weld Joints and Positions
		  ○ Welding Symbols
		• Plasma Arc Cutting

	2	• GMAW (MIG Welding) and FCAW
		  ○ Equipment and Supplies
		  ○ Equipment Assembly and Adjustment
		  ○ Flat Welding Position

Level	Quarter	Units of Study
		○ Horizontal and Vertical Welding Positions • Oxyfuel Gas Processes ○ Oxyfuel Gas Cutting and Welding Equipment and Supplies ○ Oxyfuel Gas Cutting and Welding Equipment Assembly and Adjustment ○ Oxyfuel Gas Cutting ○ Oxyfuel Gas Welding Flat Welding Position ○ Brazing and Braze Welding • Soldering
	3	• SMAW (Stick Welding) ○ Equipment and Supplies ○ Equipment Assembly and Adjustment ○ Electrodes ○ Flat Welding Position ○ Horizontal and Vertical Welding Positions • Resistance Welding (Spot Welding) ○ Equipment and Supplies • Procedures
	4	• GTAW (TIG Welding) ○ Equipment and Supplies ○ Equipment Assembly and Adjustment ○ Flat Welding Position ○ Horizontal and Vertical Welding Positions • Welding in Industry ○ Pipe and Tube Welding ○ Robotics and Welding ○ Welder Certification (introduction) • Review and Final Exam
300 **11th Grade**	**1**	• Overview ○ Class Expectations and Policies ○ Careers in Welding ○ Safety in the Welding Shop • Foundations ○ Physics of Welding ○ Math Applications for Welders ○ Weld Joints and Positions • Welding Symbols
	2	• GMAW (MIG Welding) and FCAW ○ Equipment and Supplies ○ Equipment Assembly and Adjustment ○ Flat Welding Position ○ Horizontal, Vertical and Overhead Welding Positions • Oxyfuel Gas Processes ○ Oxyfuel Gas Welding Flat Welding Position ○ Oxyfuel Gas Welding Horizontal and Vertical Welding Positions ○ Brazing and Braze Welding • Soldering
	3	• SMAW (Stick Welding) ○ Equipment and Supplies ○ Equipment Assembly and Adjustment ○ Electrodes ○ Horizontal, Vertical and Overhead Welding Positions • Surfacing
	4	• GTAW (TIG Welding) ○ Equipment and Supplies ○ Equipment Assembly and Adjustment ○ Horizontal, Vertical and Overhead Welding Positions • Welding in Industry ○ Special Welding and Cutting Processes ○ Inspecting and Testing Welds ○ Welder Certification • Review • Final Exam
400 **12th Grade**	**1**	• Overview ○ Class Expectations and Policies ○ Careers in Welding

Level	Quarter	Units of Study
		○ Safety in the Welding Shop • Foundations ○ Physics of Welding ○ Weld Joints and Positions • Welding Symbols
	2	• GMAW (MIG Welding) and FCAW ○ Flat, Horizontal, Vertical and Overhead Welding Positions • Oxyfuel Gas Processes ○ Oxyfuel Gas Welding Horizontal and Vertical Welding Positions • Brazing and Braze Welding
	3	• SMAW (Stick Welding) • Flat, Horizontal, Vertical and Overhead Welding Positions
	4	• GTAW (TIG Welding) ○ Horizontal, Vertical and Overhead Welding Positions • Welding in Industry ○ Internships ○ Welder Certification • Review • Final Exam

Syracuse City School District
Career and Technical Education Program
Course Syllabus
WLD100: Welding 100

Pathway Overview

The Welding program is designed to give students a solid foundation in the knowledge and technical skills that will prepare them for positions as entry-level welders or for advanced placement in post-secondary education. The program provides students with the skills of arc welding, resistance welding, brazing and soldering, as well as cutting, heat-treating and metallurgy. Students will also gain knowledge of electrical systems, power sources and different welding technologies, welding systems, print interpretation and measurement, as well as the use and interpretation of visual symbols related to welding. Students will have the opportunity to intern at many local businesses as well as work on customer projects and design. Students who excel in this course will have the opportunity to work toward their Level 1–Entry Welder Certification through the American Welding Society (AWS).

Course Description

Students in the Welding 100 course will study the equipment and techniques used for the welding processes most often used in today's industry including plasma arc cutting, oxyfuel gas cutting and welding, Gas Metal Arc Welding (GMAW), Flux-Cored Arc Welding (FCAW), Shielded Metal Arc Welding (SMAW), and Gas Tungsten Arc Welding (GTAW). Flat welding positions and basic joints will be practiced. Pipe and tube welding will be introduced. Classroom instruction will also include career exploration in welding, safety, design, welding theory, math, communication and organizational skills, and introduction to welder certification. As students become proficient in all welding areas, they will have the opportunity to work on customer projects and design.

Work-Based Learning

Students will be connected with welding professionals in the community through Career Coaching, field trips and job shadowing which could lead to further opportunities for direct job training and real-world experience. Students will create and maintain a portfolio of their work-based learning experiences throughout the program to document the development of their skills.

Additional Learning Opportunities

- **Micro-credentials:** Students may pursue learning experiences and credentials depending on the requirements of the projects that they are involved in. Some examples for this pathway include, but are not limited to:
  - OSHA 10 Construction Safety Certification
  - NABTU (North America's Building Trades Unions) Multi-Craft Core Curriculum (MC3)
  - Other relevant certifications as they become available through industry collaborations, teacher certifications and student interest.
- **Summer Bridge Enrichment:** Students will have the opportunity to participate in cross-curricular Summer Bridge programs to enhance and enrich their skills. Students will explore and create solutions that address authentic needs in the school and wider community with the involvement of local industry professionals. Students will build on skills learned during the school year to work collaboratively with students from other pathways and programs.

Pre-Requisites

N/A

Course Objectives

1. Students will learn and practice the fundamentals of different types of welding processes.
2. Students will understand and apply safe working practices in a safe work environment.
3. Students will practice safe equipment set up, adjustment and tear down, and machine and tool maintenance.
4. Students will work as part of a team to clean up and care for equipment.

Integrated Academics

N/A

Equipment and Supplies

- **School will provide:** Welding helmet, safety glasses and shields, gloves, flame retardant jacket, apron, ear protection and dust mask when needed, lockers for work clothes, materials and welding consumables, tools, and machines

- **Student will provide:** Leather work boots or shoes (steel/composite toe preferred), long work pants with no holes that cover the top of the shoe or boot, pencil, notebook with paper, and folder with pockets

Textbook

Bowditch, W., Bowditch, K., & Bowditch, M. (2016). *Welding Fundamentals, 5th Edition.* Tinley Park, IL: Goodheart-Willcox.

Grading

50% Projects, Lab and Shop Work, Participation
25% Assignments
25% Quizzes and Exams

Additional Course Policies

Attendance will be counted towards the final grade in each marking period. All work, assignments or quizzes can be made up the following class until the last day of each marking period.

Course Calendar

Quarter	Units of Study

1	• Overview
	  ○ Class Expectations and Policies
	  ○ Careers in Welding
	  ○ Safety in the Welding Shop
	• Foundations
	  ○ Welding and Cutting Processes
	  ○ Math for Welding
	  ○ Weld Joints and Positions
	• Plasma Arc Cutting

2	• GMAW (MIG Welding) and FCAW
	  ○ Equipment and Supplies
	  ○ Equipment Assembly and Adjustment
	  ○ Flat Welding Position
	• Oxyfuel Gas Processes
	  ○ Oxyfuel Gas Cutting and Welding Equipment and Supplies
	  ○ Oxyfuel Gas Cutting and Welding Equipment Assembly and Adjustment
	  ○ Oxyfuel Gas Cutting

3	• SMAW (Stick Welding)
	  ○ Equipment and Supplies
	  ○ Equipment Assembly and Adjustment
	  ○ Flat Welding Position

4	• GTAW (TIG Welding)
	  ○ Equipment and Supplies
	  ○ Equipment Assembly and Adjustment
	  ○ Flat Welding Position
	• Welding in Industry
	  ○ Pipe and Tube Welding
	• Review
	• Final Exam

Syracuse City School District
Career and Technical Education Program
Scope and Sequence
WLD100: Welding 100

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 1 **Overview** • **Class Expectations and Policies** • **Careers in Welding**	• What are the expectations in the welding classroom and shop? • What factors should be considered when identifying personal career goals? • What jobs are available in the welding field? • What skills are needed for a successful welding career? • What are the steps to finding a welding-related job? • What behaviors does an employee need to keep and advance in a career? • What are the advantages and the disadvantages of becoming an entrepreneur?	• Discuss classroom expectations and policies. • List the factors to be considered when developing personal career goals. • List welding jobs available at various educational levels. • Describe different types of skills needed for a successful welding career. • Outline the steps and processes needed to find a welding-related job. • List actions needed to keep a job and advance in a career. • Find advantages and disadvantages of becoming an entrepreneur.	**Written** • Assignment on Careers in Welding Related Fields • Quiz on Class Expectations **Performance** • Teacher Observation of Class Expectations Checklist	**Career Ready Practices** CRP 2,4,7,10 **Cluster Standards** MN 1,4 **Pathway Standards** MN-PRO 4	**ELA** RI.9-10.1,2,4,10 W.9-10.2,4,8 SL.9-10.1,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,4,9 WHST.9-10.2,4,8 **Math** **Science**
Week 2 **Overview** • **Safety in the Welding Shop**	• Why is safety a priority in the welding shop? • What hazards are found in the welding shop? • What safety precautions should be in place to minimize the risk of injury? • What sources of safety information are necessary?	• Describe clothing items that should be worn when welding or cutting. • List the various causes of fire hazards in the welding shop. • List the machinery and tool hazards present in a welding shop and the safety features that can be used in an emergency. • Outline the danger of fumes and airborne contaminants to the welder and the safety precautions that provide respiratory protection. • Cite at least five general rules to follow when storing compressed gas. • List ways to prevent injury when lifting heavy objects. • Recall where to find information about welding on hazardous containers and disposing of hazardous waste legally and safely. • Tell the purpose of and where to find SDS documents.	**Written** • Assignment on Safety in the Workplace • Quiz on Safety • Research Project on Safety Hazards **Performance** • Safety Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,5,7,8,12 **Cluster Standards** MN 3,5,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.9-10.1,2,4 W.9-10.1,2,4,5,6,7,8,9 SL.9-10.1,2,4,5,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,4,9 WHST.9-10.1,2,4,7,8,9 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Weeks 3-4 **Foundations** • **Welding and Cutting Processes**	• What welding and cutting processes are currently used in industry? • How has technology changed welding and cutting processes?	• List the welding and cutting processes currently used in industry to create and repair products. • Outline advantages of welding over other joining processes. • Identify recent developments in welding and cutting processes.	**Written** • Research Project on Different Welding and Cutting Processes and Their Application • Quiz on Welding and Cutting Processes • Self-Assessment **Performance** • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,7,8 **Cluster Standards** MN 6 **Pathway Standards** MN-PRO 5	**ELA** RI.9-10.1,2,4,5 W.9-10.2,4,5,7,8,9 SL.9-10.1,2,4,5,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,4,5,7,9 WHST.9-10.2,4,5,6,7,8,9 **Math** **Science**
Weeks 5-6 **Foundations** • **Math for Welding**	• What mathematical operations are necessary for welders to know and use?	• Explain how the academic disciplines of science, technology, engineering, and mathematics (STEM) apply to welding. • Describe the application for math in welding and in personal life. • Add, subtract, multiply and divide whole numbers, fractions, and decimals. • Use a calculator for simple calculations.	**Written** • Assignment on Adding and Subtracting Fractions • Quiz on Adding and Subtracting Fractions • Self-Assessment **Performance** • Ruler Exercise – Measuring Using a Ruler/Tape • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8,11 **Cluster Standards** MN 6 **Pathway Standards** MN-PRO 5	**ELA** RI.9-10.1,4 W.9-10.2,4 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,3,4,7 WHST.9-10.2,4 **Math** **Science**
Week 7-8 **Foundations** • **Weld Joints and Positions**	• How are the five basic weld joints used in the field? • How does a welder decide which type of weld to use?	• Identify the five basic weld joints. • Identify the types of welds that can be made on each joint. • Identify the parts of a fillet weld and a groove weld. • Recognize a stringer bead and a weave bead. • List the four welding positions. • State the conditions for welding in the four welding positions. • Describe materials utilized for welding applications.	**Written** • Assignment on Weld Joints and Angles • Quiz on Weld Joints • Self-Assessment **Performance** • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8 **Cluster Standards** MN 6 **Pathway Standards** MN-PRO 5	**ELA** RI.9-10.1,4,7 W.9-10.2,4,6 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,5,7,8 WHST.9-10.2,4,9 **Math** **Science**
Weeks 9-10 **Plasma Arc Cutting**	• What is plasma arc cutting and what is it used for? • What are the main safety considerations when using PAC equipment?	• Describe the plasma arc cutting (PAC) process. • Identify and assemble the equipment and supplies used for PAC. • Label the parts of a PAC torch. • Describe the safety considerations for PAC. • Set up and use PAC equipment for cutting.	**Written** • Assignment on Cutting Equipment and Supplies • Quiz on PAC Process • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,8,9,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.9-10.1,2,4,7 W.9-10.2,4,6,8 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,5 WHST.9-10.2,4,8 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 11 **GMAW (MIG Welding) and FCAW** • **Equipment and Supplies**	• What is GMAW and what is it used for? • What are the differences between GMAW and FCAW? • What equipment and gases are used for GMAW? • What are the main safety considerations when using GMAW?	• Identify the correct polarity to use for GMAW. • Identify similarities and differences between GMAW and FCAW. • Describe three methods of metal transfer. • Use the equipment that makes up a GMAW outfit. • Observe the operation of a wire feeder. • List the parts of a welding gun and cables. • List four gases used for GMAW. • Explain the use of a flowmeter for GMAW. • Describe the protective clothing and safety equipment for GMAW.	**Written** • Assignment on GMAW and FCAW Equipment and Supplies • Quiz on GMAW and FCAW Equipment and Supplies • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,6,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**
Weeks 12-13 **GMAW (MIG Welding) and FCAW** • **Equipment Assembly and Adjustment**	• How is a GMAW welding outfit assembled and adjusted?	• Assemble a GMAW welding outfit. • Adjust the drive mechanism for the proper pressure and alignment. • List the proper sequence for removing a bird's nest. • Adjust the shielding gas flowmeter for the proper pressure and flow rate. • Identify the electrode wire designations for GMAW electrodes. • Identify the two adjustments that are made to the welding machine. • Identify safety precautions for GMAW.	**Written** • Assignment on GMAW and FCAW Equipment Assembly • Quiz on GMAW and FCAW Equipment Assembly • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**
Weeks 14-17 **GMAW (MIG Welding) and FCAW** • **Flat Welding Position**	• What are the advantages and disadvantages of GMAW and FCAW? • Which type of current is most commonly used for GMAW welding? • What factors must be considered before selecting the electrode and shielding gas?	• Describe GMAW processes. • Determine the appropriate electrode to use with GMAW in the flat welding position. • Identify the correct electrode extension to use with GMAW using different metal transfer methods. • Lay a weld bead on a plate using GMAW. • Make a fillet weld on a lap joint and on a T-joint in the flat welding position. • Weld a butt joint in the flat welding position. • Describe how to weld aluminum using GMAW. • Identify various weld defects.	**Written** • Assignment on GMAW vs. FCAW • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**
Week 18 **Oxyfuel Gas Processes**	• What are oxyfuel gas processes and what are they used for?	• Identify the parts and the function of an oxyfuel gas cutting or welding outfit. • Describe the safety features of an oxyfuel cutting or welding outfit.	**Written** • Assignment on Welding Gases and Processes	**Career Ready Practices** CRP 2,4,8	**ELA** RI.9-10.1,2,4 W.9-10.2,4,9 SL.9-10.1,2,4,6 L.9-10.1-6

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
• **Oxyfuel Gas Cutting and Welding Equipment and Supplies**	• What equipment and gases are used for oxyfuel cutting and welding?	• Describe the protective clothing and the safety precautions that must be taken when performing oxyfuel cutting or welding.	• Quiz on Different Gases Used in Welding • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**Literacy** RST.9-10.1,2,3,4,7 WHST.9-10.2,4,9 **Math** **Science**
Week 19 **Oxyfuel Gas Processes** • **Oxyfuel Gas Cutting and Welding Equipment Assembly and Adjustment**	• What are the main safety considerations when using oxyfuel gas processes? • How is an oxyfuel cutting or welding outfit assembled and adjusted?	• List the procedure to assemble and turn on an oxyfuel gas cutting and welding outfit. • Describe how to check for leaks in an oxyfuel cutting and welding system. • Identify three types of flames that can be produced when burning oxygen and acetylene. • Describe the steps to light and adjust the flame on an oxyfuel cutting torch and an oxyfuel welding torch. • Describe how to shut down an oxyfuel cutting or welding outfit.	**Written** • Assignment on Oxyfuel Gas Equipment Assembly • Quiz on Oxyfuel Gas Equipment Assembly • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**
Week 20 **Oxyfuel Gas Processes** • **Oxyfuel Gas Cutting**	• How are cuts made using an oxyfuel gas cutting outfit?	• List the fuel gases that are used for oxyfuel gas cutting. • Perform cuts manually with a cutting torch or cutting torch attachment. • Practice cuts with an oxyfuel gas cutting machine. • Identify the basic types of cutting machines.	**Written** • Assignment on Welding Gases • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8 **Math** **Science**
Week 21 **SMAW (Stick Welding)** • **Equipment and Supplies**	• What equipment and supplies are found in a SMAW station?	• Explain the differences between direct current (DC) and alternating current (AC). • Identify American Welding Society (AWS) abbreviations regarding welding current polarity. • Name the equipment and accessories used in SMAW. • List the components of an arc welding outfit and arc welding station. • List factors to consider when selecting an arc welding machine. • Describe how to set-up machinery.	**Written** • Assignment on SMAW Equipment and Supplies • Quiz on Parts of a SMAW Outfit • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation	**Career Ready Practices** CRP 2,4,8 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**
Week 22 **SMAW (Stick Welding)**	• How is the SMAW station prepared for work?	• Describe the assembly of a welding machine, leads, and electrode holder.	**Written** • Assignment on Setting Up SMAW Outfit	**Career Ready Practices** CRP 2,4,8	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
• **Equipment Assembly and Adjustment**	• What safety precautions should be considered when setting up a SMAW station?	• Describe the procedure for inspecting a SMAW outfit. • Estimate the proper amperage and polarity on a welding machine.	• Quiz on Assembly of a SMAW Outfit • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation		L.9-10.1-6
				Cluster Standards MN 3,6	**Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9
				Pathway Standards MN-PRO 2,5	**Math**
					Science
Weeks 23-30 **SMAW (Stick Welding)** • **Flat Welding Position**	• How are welds made using a SMAW welding outfit? • What weld angles are used for welding in the flat position?	• Identify the safety rules required for arc welding. • Describe methods to prevent or reduce arc blow. • Run a weld bead using the correct electrode angles. • Use drag welding techniques. • Clean a weld. • Make a fillet weld on a lap joint, inside corner, and T-joint in the flat welding position. • Identify weld defects.	**Written** • Assignment on SMAW Flat Welding Position and When to Use It • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6
				Cluster Standards MN 3,6	**Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,7,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science
Week 31 **GTAW (TIG Welding)** • **Equipment and Supplies**	• What is GTAW? • Why is a post flow of shielding gas used with GTAW? • What type of connection is used for shielding gas and water hoses? • What are the major types of electrodes used in GTAW?	• Describe the principles of gas tungsten arc welding (GTAW). • Identify the equipment and supplies involved with GTAW. • List the parts of a GTAW torch. • Describe the functions of the cables and hoses. • Observe safety considerations when gas tungsten arc welding.	**Written** • Assignment on GTAW Equipment and Supplies • Quiz on GTAW Welding Equipment • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,3,4,8,11	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6
				Cluster Standards MN 3,6	**Literacy** RST.9-10.1,2,3,4,7,8 WHST.9-10.2,4,8,9
				Pathway Standards MN-PRO 2,5	**Math**
					Science
Week 32 **GTAW (TIG Welding)** • **Equipment Assembly and Adjustment**	• What type of current requires the high-frequency voltage to be used continuously? • What are the two ways to increase the current while welding?	• Assemble a GTAW welding outfit. • Assemble a GTAW torch. • Adjust the shielding gas flowmeter for the proper flow rate. • Select the proper current amount and type for the metal to be welded. • Identify electrode type designations for GTAW electrodes. • Prepare an electrode for GTAW. • Observe the metal cleaning processes used in GTAW.	**Written** • Assignment on Setting Up a GTAW Outfit • Quiz on Adjusting Equipment Used During GTAW Welding • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8,11	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6
				Cluster Standards MN 3,6	**Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9
				Pathway Standards MN-PRO 2,5	**Math**
					Science
Weeks 33-36	• How are welds made in the flat welding position	• Describe the GTAW process.	**Written**	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
GTAW (TIG Welding) • **Flat Welding Position**	using a GTAW welding outfit? • What weld angles are used for welding in the flat position?	• Locate the appropriate welding rod to use when gas tungsten arc welding. • Lay a bead on a plate using GTAW. • Reproduce a fillet weld on a lap joint in the flat welding position. • Reproduce a fillet weld on a T-joint in the flat welding position. • Weld a butt joint in the flat welding position. • Describe the use of a backing when welding aluminum using GTAW. • Identify various welding defects.	• Assignment on GTAW Flat Welding Position • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test		SL.9-10.1,2,4,6 L.9-10.1-6
				Cluster Standards MN 3,6	**Literacy** RST.9-10.1,2,3,4,7,8,9 WHST.9-10.2,4,7,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science
Weeks 37-39 **Welding in Industry** • **Pipe and Tube Welding**	• What procedures are used for welding pipes and tubes?	• Identify the differences between pipes and tubes. • List the names of the welding passes used in welding pipe with walls more than 3/16″ (5 mm) thick. • Demonstrate the procedures to weld pipes or tubes using SMAW, GTAW, SMAW and FCAW. • Observe the differences in technique for uphill and downhill welding.	**Written** • Assignment on Types of Pipes and Tubes • Quiz on Pipe and Tube Welding • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 2,4,6,8,11	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6
				Cluster Standards MN 3,6	**Literacy** RST.9-10.1,2,3,4,7,8,9 WHST.9-10.2,4,7,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science
Week 40 **Review** **Final Exam**	• What are the main learning goals for this past year in welding?	• Complete the written and performance assessments demonstrating a thorough knowledge of welding.	• Written and Performance Final Exam	**Career Ready Practices** CRP 2,4,6,8,11	**ELA** RI.9-10.1,2,4,7,8 W.9-10.2,4,6,8,9 SL.9-10.1,2,4,6 L.9-10.1-6
				Cluster Standards MN 1-6	**Literacy** RST.9-10.1,2,3,4,7,8,9 WHST.9-10.2,4,6,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science

Syracuse City School District
Career and Technical Education Program
Course Syllabus
WLD200: Welding 200

Pathway Overview

The Welding program is designed to give students a solid foundation in the knowledge and technical skills that will prepare them for positions as entry-level welders or for advanced placement in post-secondary education. The program provides students with the skills of arc welding, resistance welding, brazing and soldering, as well as cutting, heat-treating and metallurgy. Students will also gain knowledge of electrical systems, power sources and different welding technologies, welding systems, print interpretation and measurement, as well as the use and interpretation of visual symbols related to welding. Students will have the opportunity to intern at many local businesses as well as work on customer projects and design. Students who excel in this course will have the opportunity to work toward their Level 1–Entry Welder Certification through the American Welding Society (AWS).

Course Description

Students in the Welding 200 course will continue to study the equipment and techniques used for the welding processes most often used in today's industry including plasma arc cutting, oxyfuel gas cutting and welding, Gas Metal Arc Welding (GMAW), Flux-Cored Arc Welding (FCAW), Shielded Metal Arc Welding (SMAW), and Gas Tungsten Arc Welding (GTAW), brazing and braze welding, soldering, resistance welding and robotic welding. Flat, horizontal, and vertical welding positions and basic joints, pipe, and tube welding will be practiced. Classroom instruction will also include career exploration in welding, safety, design, welding theory, math applications, physics of welding, communication and organizational skills, welding symbols and welder certification. As students become proficient in all welding areas, they will have the opportunity to work on customer projects and design.

Work-Based Learning

Students will be connected with welding professionals in the community through Career Coaching, field trips and job shadowing which could lead to further opportunities for direct job training and real-world experience. Students will create and maintain a portfolio of their work-based learning experiences throughout the program to document the development of their skills.

Additional Learning Opportunities

- **Micro-credentials:** Students may pursue learning experiences and credentials depending on the requirements of the projects that they are involved in. Some examples for this pathway include, but are not limited to:
    - OSHA 10 Construction Safety Certification
    - NABTU (North America's Building Trades Unions) Multi-Craft Core Curriculum (MC3)
    - Other relevant certifications as they become available through industry collaborations, teacher certifications and student interest.
- **Summer Bridge Enrichment:** Students will have the opportunity to participate in cross-curricular Summer Bridge programs to enhance and enrich their skills. Students will explore and create solutions that address authentic needs in the school and wider community with the involvement of local industry professionals. Students will build on skills learned during the school year to work collaboratively with students from other pathways and programs.

Pre-Requisites

WLD100: Welding 100

Course Objectives

1. Students will learn and practice the fundamentals of different types of welding processes.
2. Students will understand and apply safe working practices in a safe work environment.
3. Students will practice safe equipment set up, adjustment and tear down, and machine and tool maintenance.
4. Students will work as part of a team to clean up and care for equipment.

Integrated Academics

N/A

Equipment and Supplies

- **School will provide:** Welding helmet, safety glasses and shields, gloves, flame retardant jacket, apron, ear protection and dust mask when needed, lockers for work clothes, materials and welding consumables, tools, and machines
- **Student will provide:** Leather work boots or shoes (steel/composite toe preferred), long work pants with no holes that cover the top of the shoe or boot, pencil, notebook with paper, and folder with pockets

Textbook

Bowditch, W., Bowditch, K., & Bowditch, M. (2016). *Welding Fundamentals, 5th Edition.* Tinley Park, IL: Goodheart-Willcox.

Grading

50% Projects, Lab and Shop Work, Participation
25% Assignments
25% Quizzes and Exams

Additional Course Policies

Attendance will be counted towards the final grade in each marking period. All work, assignments or quizzes can be made up the following class until the last day of each marking period.

Course Calendar

Quarter	Units of Study

1	• Overview
	  ○ Class Expectations and Policies
	  ○ Careers in Welding
	  ○ Safety in the Welding Shop
	• Foundations
	  ○ Welding and Cutting Processes
	  ○ Physics of Welding
	  ○ Math for Welding
	  ○ Math Applications for Welders
	  ○ Weld Joints and Positions
	  ○ Welding Symbols
	• Plasma Arc Cutting

2	• GMAW (MIG Welding) and FCAW
	  ○ Equipment and Supplies
	  ○ Equipment Assembly and Adjustment
	  ○ Flat Welding Position
	  ○ Horizontal and Vertical Welding Positions
	• Oxyfuel Gas Processes
	  ○ Oxyfuel Gas Cutting and Welding Equipment and Supplies
	  ○ Oxyfuel Gas Cutting and Welding Equipment Assembly and Adjustment
	  ○ Oxyfuel Gas Cutting
	  ○ Oxyfuel Gas Welding Flat Welding Position
	  ○ Brazing and Braze Welding
	  ○ Soldering

3	• SMAW (Stick Welding)
	  ○ Equipment and Supplies
	  ○ Equipment Assembly and Adjustment
	  ○ Electrodes
	  ○ Flat Welding Position
	  ○ Horizontal and Vertical Welding Positions
	• Resistance Welding (Spot Welding)
	  ○ Equipment and Supplies
	  ○ Procedures

4	• GTAW (TIG Welding)
	  ○ Equipment and Supplies
	  ○ Equipment Assembly and Adjustment
	  ○ Flat Welding Position
	  ○ Horizontal and Vertical Welding Positions
	• Welding in Industry
	  ○ Pipe and Tube Welding
	  ○ Robotics and Welding
	  ○ Welder Certification (introduction)
	• Review and Final Exam

Syracuse City School District
Career and Technical Education Program
Scope and Sequence
WLD 200: Welding 200

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 1 **Overview** • Class Expectations and Policies • Careers in Welding	• What are the expectations in the welding classroom and shop? • What factors should be considered when identifying personal career goals? • What jobs are available in the welding field? • What skills are needed for a successful welding career? • What are the steps to finding a welding-related job? • What behaviors does an employee need to keep and advance in a career? • What are the advantages and the disadvantages of becoming an entrepreneur?	• Discuss classroom expectations and policies. • Describe the factors to be considered when developing personal career goals. • Identify welding jobs available at various educational levels. • Summarize the different types of skills needed for a successful welding career. • Analyze the steps and processes needed to find a welding-related job. • Demonstrate actions needed to keep a job and advance in a career. • Compare the advantages and disadvantages of becoming an entrepreneur.	**Written** • Assignment on Careers in Welding Related Fields • Quiz on Class Expectations **Performance** • Teacher Observation of Class Expectations Checklist	**Career Ready Practices** CRP 2,4,7,10 **Cluster Standards** MN 1,4 **Pathway Standards** MN-PRO 4	**ELA** RI.9-10.1,2,4,10 W.9-10.2,4,8 SL.9-10.1,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,4,9 WHST.9-10.2,4,8 **Math** **Science**
Week 2 **Overview** • Safety in the Welding Shop	• Why is safety a priority in the welding shop? • What hazards are found in the welding shop? • What safety precautions should be in place to minimize the risk of injury? • What sources of safety information are necessary?	• Select which clothing items should be worn when welding or cutting. • Explain the various causes of fire hazards. • Identify the machinery and tool hazards present in a welding shop and the safety features that can be used in an emergency. • Summarize the danger of fumes and airborne contaminants to the welder and the safety precautions that provide respiratory protection. • Cite at least five general rules to follow when storing compressed gas. • List ways to prevent injury when lifting heavy objects. • Explain where to find information about welding on hazardous	**Written** • Assignment on Safety in the Workplace • Quiz on Safety • Research Project on Safety Hazards **Performance** • Safety Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,5,7,8,11,12 **Cluster Standards** MN 3,5,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.9-10.1,2,4 W.9-10.1,2,4,5,6,7,8,9 SL.9-10.1,2,4,5,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,4,9 WHST.9-10.1,2,4,7,8,9 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		containers and disposing of hazardous waste legally and safely. • Show the purpose of and where to find SDS documents.			
Week 3 **Foundations** • Welding and Cutting Processes	• What welding and cutting processes are currently used in industry? • How has technology changed welding and cutting processes?	• Demonstrate the welding and cutting processes currently used in industry to create and repair products. • Explain the advantages of welding over other joining processes. • Compare the various welding and cutting processes currently used in industry.	**Written** • Research Project on Different Welding and Cutting Processes and Their Application • Quiz on Welding and Cutting Processes • Self-Assessment **Performance** • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,7,8 **Cluster Standards** MN 6 **Pathway Standards** MN-PRO 5	**ELA** RI.9-10.1,2,4,5 W.9-10.2,4,5,7,8,9 SL.9-10.1,2,4,5,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,4,5,7,9 WHST.9-10.2,4,5,6,7,8,9 **Math** **Science**
Week 4 **Foundations** • Physics of Welding	• Why is welding more efficient than riveting and machining? • What three methods are used to achieve a weld? • What happens to the size of base metal when it is heated?	• List the three general methods by which a weld is achieved. • Compare the difference between chemical and mechanical properties and give examples of each. • Show the effects of welding on metal. • Recall the processes used to heat-treat metal. • Find the relationship between voltage and current. • Select examples of US customary and SI metric units of measurement.	**Written** • Assignment on Heat Transfer and Physical Properties of Metal • Quiz on Physical Properties of Metal • Self-Assessment **Performance** • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,5,7,9 WHST.9-10.2,4,8,9 **Math** **Science**
Week 5-6 **Foundations** • Math for Welding • Math Applications for Welders	• What mathematical operations are necessary for welders to know and use? • What math applications are necessary for welders to know and use?	• Measure using both the US customary system and the SI metric system. • Convert lengths from US customary units to SI metric units and from SI metric units to US customary units. • Calculate the perimeter, area, and volume of common shapes. • Convert welding values from US customary unites to SI metric units and from SI metric units to US customary units. • Demonstrate knowledge and skills through application and projects.	**Written** • Assignment on Perimeter, Area, and Volume • Assignment on Converting Measurements • Quiz on Measurement Conversions • Self-Assessment **Performance** • Ruler Exercise – Measuring Using a Ruler/Tape • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8,11 **Cluster Standards** MN 6 **Pathway Standards** MN-PRO 5	**ELA** RI.9-10.1,4 W.9-10.2,4 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,3,4,7 WHST.9-10.2,4 **Math** **Science**
Week 7 **Foundations**	• How are the five basic weld joints used in the field?	• Practice the five basic weld joints. • Describe the types of welds that can be made on each joint.	**Written** • Assignment on Weld Joints and Angles • Quiz on Weld Joints	**Career Ready Practices** CRP 2,4,8	**ELA** RI.9-10.1,4,7 W.9-10.2,4,6 SL.9-10.1,2,4,6 L.9-10.1-6

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
• Weld Joints and Positions	• How does a welder decide which type of weld to use?	• Explain the parts of a fillet weld and a groove weld. • Practice a stringer bead and a weave bead. • Practice the four welding positions. • Recognize the conditions for welding in the four welding positions.	• Self-Assessment **Performance** • Teacher Observation Checklist	**Cluster Standards** MN 6 **Pathway Standards** MN-PRO 5	**Literacy** RST.9-10.1,2,3,4,5,7,8 WHST.9-10.2,4,9 **Math** **Science**
Week 8-9 **Foundations** • Welding Symbols	• At what angle are the axes positioned to create an isometric drawing? • What does the welding symbol tell the welder?	• Memorize the method for making a mechanical drawing of a three-dimensional object, using the orthographic projection process. • List the names of the views used in an orthographic projection. • Describe the characteristics of an isometric drawing. • Identify the basic types of welds indicated on the ANSI/AWS welding symbol. • Locate information on the weld symbol to determine the size of the root opening, the groove angle, and the desired size, contour, and finish of the weld.	**Written** • Assignment on Welding Symbols • Quiz on Welding Symbols • Research Project on How Welding Symbols Are Used • Self-Assessment **Performance** • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,7,8,11 **Cluster Standards** MN 6 **Pathway Standards** MN-PRO 5	**ELA** RI.9-10.1,4 W.9-10.2,4,8 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,3,4,7,9 WHST.9-10.2,4,7,8,9 **Math** **Science**
Week 10 **Plasma Arc Cutting** • Review	• What is plasma arc cutting and what is it used for? • What are the main safety considerations when using PAC equipment?	• Practice the plasma arc cutting (PAC) process. • Choose and assemble the equipment and supplies used for PAC. • Inspect the parts of a PAC torch. • Apply safety considerations for PAC. • Demonstrate how to set up PAC equipment for cutting. • Evaluate cuts using PAC equipment.	**Written** • Assignment on Cutting Equipment and Supplies • Quiz on PAC Process • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,8,9,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.9-10.1,2,4,7 W.9-10.2,4,6,8 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,5 WHST.9-10.2,4,8 **Math** **Science**
Week 11 **GMAW (MIG Welding) and FCAW** • Equipment and Supplies • Equipment Assembly and Adjustment	• What is GMAW and what is it used for? • What are the differences between GMAW and FCAW? • What equipment and gases are used for GMAW? • What are the main safety considerations when using GMAW?	• Compare GMAW and FCAW. • Explain the correct polarity to use for GMAW and FCAW. • Demonstrate three methods of metal transfer. • Use the equipment that makes up a GMAW and FCAW outfit. • Explain the operation of a wire feeder. • Breakdown the parts of a welding gun and cables.	**Written** • Assignment on GMAW and FCAW Equipment Assembly • Quiz on GMAW and FCAW Equipment, Supplies and Assembly • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist	**Career Ready Practices** CRP 2,4,8,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,6,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	• How is a GMAW welding outfit assembled and adjusted?	• Describe four gases used for GMAW and identify the most common shielding gas used for FCAW. • Explain the use of a flowmeter for GMAW and FCAW. • Use protective clothing and equipment for GMAW and FCAW. • Assemble a GMAW/FCAW welding outfit. • Adjust the drive mechanism for the proper pressure and alignment. • List the proper sequence for removing a bird's nest. • Adjust the shielding gas flowmeter for the proper pressure and flow rate. • Identify the electrode wire designations for GMAW and FCAW electrodes. • Identify the two adjustments that are made to the welding machine. • Identify safety precautions for GMAW and FCAW.	• Teacher Observation Checklist		
Weeks 12-13 **GMAW (MIG Welding) and FCAW** • Flat Welding Position	• What are the advantages and disadvantages of GMAW and FCAW? • Which type of current is most commonly used for GMAW welding? • What factors must be considered before selecting the electrode and shielding gas?	• Identify the GMAW and FCAW processes. • Determine the appropriate electrode to use with GMAW and FCAW in the flat welding position. • Identify the correct electrode extension to use with GMAW and FCAW using different metal transfer methods. • Lay a weld bead on a plate using GMAW and FCAW. • Make a fillet weld on a lap joint in the flat welding position. • Make a fillet weld on a T-joint in the flat welding position. • Weld a butt joint in the flat welding position. • Describe how to weld aluminum using GMAW. • Identify various weld defects.	**Written** • Assignment on GMAW vs. FCAW • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**
Weeks 14-17 **GMAW (MIG Welding) and FCAW**	• What are the advantages of backhand welding over forehand welding?	• Explain why flat position welding is preferred over out-of-position welding. • Identify the correct welding gun angle for out-of-position welding.	**Written** • Assignment on GMAW vs. FCAW • Self-Assessment	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
• Horizontal and Vertical Welding Positions	• What weld pool shape is used when welding a fillet weld in the vertical welding position? • What two types of weld beads can be used to fill or build up a weld?	• Weld in the horizontal welding position using GMAW and FCAW. • Weld in the vertical welding position using GMAW and FCAW.	**Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**
Week 18 **Oxyfuel Gas Processes** • Oxyfuel Gas Cutting and Welding Equipment and Supplies • Oxyfuel Gas Cutting and Welding Equipment Assembly and Adjustment • Oxyfuel Gas Cutting	• What are oxyfuel gas processes and what are they used for? • What equipment and gases are used for oxyfuel cutting and welding? • What are the main safety considerations when using oxyfuel processes? • How is an oxyfuel cutting or welding outfit assembled and adjusted? • How are cuts made using an oxyfuel gas cutting outfit?	• Explain the parts and function of an oxyfuel gas cutting or welding outfit. • Explain the safety features of an oxyfuel cutting or welding outfit. • Demonstrate the protective clothing and the safety precautions that must be used for oxyfuel cutting or welding. • Demonstrate the steps required to assemble an oxyfuel gas cutting and welding outfit. • Safely turn on, check for leaks, and shut down an oxyfuel cutting and welding outfit. • Compare three types of flames that can be produced when burning oxygen and acetylene. • Demonstrate the steps to light and adjust the flame on an oxyfuel cutting torch and an oxyfuel welding torch. • Select the fuel gases to use for oxyfuel gas cutting. • Perform cuts manually with a cutting torch or cutting torch attachment. • Demonstrate cuts with an oxyfuel gas cutting machine.	**Written** • Assignment on Welding Gases • Quiz on Different Gases Used in Welding • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**
Week 19 **Oxyfuel Gas Processes** • Oxyfuel Gas Welding Flat Welding Position	• How are welds made using an oxyfuel gas welding outfit? • What weld angles are used for welding in the flat position?	• Identify the four positions used in welding and explain which is the most efficient. • Use the proper protective clothing for oxyfuel gas welding. • Explain how to hold a torch when forehand welding and when backhand welding. • Practice the torch angles used to weld in the flat position. • Carry a weld pool along a weld joint. • Weld edge, corner, and flanged butt joints without a welding rod.	**Written** • Assignment on Welding Positions • Quiz on Oxyfuel Gas Welding Processes • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		• Select a welding rod. • Lay a weld bead on a plate using a welding rod. • Lay a fillet weld on lap and T-joints using a welding rod. • Weld a butt joint using a welding rod. • Identify weld defects.	• Welding Coupon Preparation • Welding Joint Bend Test		
Week 20 **Oxyfuel Gas Processes** • Brazing and Braze Welding • Soldering	• What is the difference between brazing and braze welding? • How are brazing filler metals chosen? • How is a joint prepared for brazing or braze welding? • How does a welder choose the correct equipment for brazing and braze welding? • What makes a good braze weld? • What safety precautions are necessary for brazing, braze welding and soldering? • What are the principles of soldering? • What are the advantages and disadvantages of soldering? • How does a welder choose the correct filler metals and fluxes for different types of soldering work?	• Explain the major difference between the brazing and braze welding processes. • Describe the available brazing filler metals and the factors to be considered when choosing a filler metal. • Observe the procedure for properly cleaning a joint prior to brazing or braze welding. • Select the correct torch tip, rod diameter, and flux for brazing and braze welding. • List the safety precautions for brazing and braze welding. • Describe the procedures for brazing and braze welding. • Describe the principles of soldering. • Identify the advantages of soldering. • Select the appropriate filler metal and flux for soldering. • Explain the purposes and classifications of soldering fluxes. • Observe common hazards associated with lead-containing solders and fluxes. • List acceptable solders for drinking water systems. • Discuss the soldering process, including the steps needed to clean metal surfaces prior to soldering. • Follow safety precautions and be aware of potential health hazards related to soldering. • Solder a lap joint and a pipe joint.	**Written** • Assignment on Brazing, Soldering, and Heat Transfer • Quiz on Brazing, Soldering and Heat Transfer • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**
Week 21 **SMAW (Stick Welding)**	• What equipment and supplies are found in a SMAW station?	• Explain the differences between direct current (DC) and alternating current (AC).	**Written** • Assignment on Setting Up SMAW Outfit	**Career Ready Practices** CRP 2,4,8	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
• Equipment and Supplies • Equipment Assembly and Adjustment	• How is the SMAW station prepared for work? • What safety precautions should be considered when setting up a SMAW station?	• Interpret American Welding Society (AWS) abbreviations regarding welding current polarity. • Identify the equipment and accessories used in shielded metal arc welding (SMAW). • List the components of an arc welding outfit and arc welding station. • Identify factors to consider when selecting an arc welding machine. • Explain the assembly of a welding machine, leads, and electrode holder. • Demonstrate the procedure for inspecting a SMAW outfit. • Predict the proper amperage and polarity on a welding machine.	• Quiz on Parts of a SMAW Outfit • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation	**Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9 **Math** **Science**
Week 22 **SMAW (Stick Welding)** • Electrodes	• What information does the AWS electrode identification system provide? • What are the purposes of an electrode covering? • Why should electrodes be kept in their shipping containers until they are used? • How does a welder decide what electrode to use in different conditions?	• Identify carbon and low alloy SMAW electrodes. • List six purposes of an electrode covering. • Interpret the AWS electrode identification system. • Predict the trial amperage of a welding machine using the rule-of-thumb method. • Select an electrode to meet the requirements of a weld. • Observe two means of storing electrodes.	**Written** • Assignment on SMAW Electrodes • Quiz on Electrodes • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8,11 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.9-10.1,4 W.9-10.2,4,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,3,4,7,9 WHST.9-10.2,4,9 **Math** **Science**
Weeks 23-25 **SMAW (Stick Welding)** • Flat Welding Position	• How are welds made in the flat welding position using a SMAW welding outfit? • What weld angles are used for welding in the flat position?	• Discuss the safety rules required for arc welding. • Explain methods to prevent or reduce arc blow. • Practice a weld bead using the correct electrode angles. • Model drag welding techniques. • Clean a weld. • Apply a fillet weld on a lap joint, inside corner, and T-joint in the flat welding position using SMAW. • Evaluate weld defects.	**Written** • Assignment on SMAW Flat Welding Position and When to Use It • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,7,8,9 **Math** **Science**
Weeks 26-29	• How are welds made in the horizontal and		**Written**	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
SMAW (Stick Welding) • Horizontal and Vertical Welding Positions	vertical positions using a SMAW welding outfit? • What weld angles are used for welding in the horizontal and vertical positions?	• Identify the proper protective clothing to be worn when welding out of position. • Weld in the horizontal and vertical welding positions. • Practice the procedure for welding uphill and downhill.	• Assignment on SMAW Welds and Positions: When to Use Each • Quiz on SMAW Welding Positions • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test		SL.9-10.1,2,4,6 L.9-10.1-6
				Cluster Standards MN 3,6	**Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,7,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science
Week 30 **Resistance Welding (Spot Welding)** • Equipment and Supplies • Procedures	• What is electrical resistance and how is it applied in resistance welding? • What equipment is used for resistance welding and how is it set up and adjusted? • How are resistance welds made?	• Explain the principle of electrical resistance and how it is used in resistance welding. • List the three most common resistance welding machine designs. • Explain how a step-down transformer affects voltage and current. • Explain the three time intervals in resistance welding schedules. • Compare the properties of a material suitable for use as an electrode in resistance welding. • Describe the regular checks needed for safe operation of a resistance spot welding machine. • Select the proper spot welding machine for the welding to be done. • Explain how to select and prepare the electrodes for resistance spot welding. • Describe the methods used to determine the correct force for spot welding. • Determine the weld time and current needed for resistance welding mild steel. • Make resistance spot welds on mild steel and aluminum. • Explain the method used to test for a good spot weld and the signs that indicate a weld is of the desired quality.	**Written** • Assignment on Setting Up Resistance Welding Outfit • Quiz on Parts of a Resistance Welding Outfit and Procedures • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,8,11,12	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6
				Cluster Standards MN 3,6	**Literacy** RST.9-10.1,2,3,4,7,9 WHST.9-10.2,4,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		• Discuss the process of projection welding. • Evaluate the process of resistance seam welding.			
Week 31 **GTAW (TIG Welding)** • Equipment and Supplies • Equipment Assembly and Adjustment	• What is GTAW? • Why is a post flow of shielding gas used with GTAW? • What type of connection is used for shielding gas and water hoses? • What are the major types of electrodes used in GTAW? • What type of current requires the high-frequency voltage to be used continuously? • What are the two ways to increase the current while welding?	• Describe the principles of gas tungsten arc welding (GTAW). • Identify the equipment and supplies involved with GTAW. • Describe the parts of a GTAW torch and how it is used. • Describe the functions of the cables and hoses. • Observe safety considerations when gas tungsten arc welding. • Assemble a GTAW welding outfit. • Demonstrate adjusting the shielding gas flowmeter for the proper flow rate. • Predict the proper current amount and type for the metal to be welded. • Explain electrode type designations for GTAW electrodes. • Use an electrode for GTAW • Apply the metal cleaning processes used in GTAW.	**Written** • Assignment on Setting Up a GTAW Outfit • Quiz on Equipment Used During GTAW Welding • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,3,4,8,11 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,8,9 WHST.9-10.2,4,8,9 **Math** **Science**
Weeks 32-33 **GTAW (TIG Welding)** • Flat Welding Position	• How are welds made in the flat welding position using a GTAW welding outfit? • What weld angles are used for welding in the flat position?	• Discuss the GTAW process. • Determine the appropriate welding rod to use when gas tungsten arc welding. • Practice laying a bead on a plate using GTAW. • Make a fillet weld on a lap joint in the flat welding position. • Make a fillet weld on a T-joint in the flat welding position. • Weld a butt joint in the flat welding position. • Explain the use of a backing when welding aluminum using GTAW. • Analyze various welding defects.	**Written** • Assignment on GTAW Flat Welding Position • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,8,9 WHST.9-10.2,4,7,8,9 **Math** **Science**
Weeks 34-36 **GTAW (TIG Welding)** • Horizontal and Vertical	• How are welds made in the horizontal and vertical welding positions using a SMAW welding outfit? • What weld angles are used for welding in the	• Remember why out-of-position welding is often an important part of welder qualification tests. • Observe the correct torch and welding rod angles for out-of-position welding. • Weld in the horizontal welding position with GTAW.	**Written** • Assignment on GTAW Welding Proper Techniques and Positions • Self-Assessment **Performance** • Safety Checklist	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,8,9 WHST.9-10.2,4,7,8,9

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Welding Positions	horizontal and vertical positions?	• Weld in the vertical welding position with GTAW.	• Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Pathway Standards** MN-PRO 1-5	**Math** **Science**
Week 37 **Welding in Industry** • Pipe and Tube Welding	• What procedures are used for welding pipes and tubes?	• Compare the differences between pipes and tubes. • Identify the names of the welding passes used in welding pipe with walls more than 3/16″ (5 mm) thick. • Demonstrate the procedures to weld pipes or tubes using SMAW, GTAW, SMAW and FCAW. • Discuss the differences in technique for uphill and downhill welding.	**Written** • Assignment on Types of Pipes and Tubes • Quiz on Pipe and Tube Welding • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 2,4,6,8,11 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,8,9 WHST.9-10.2,4,7,8,9 **Math** **Science**
Week 38 **Welding in Industry** • Robotics and Welding	• How is robotic welding equipment used in manufacturing? • What are the advantages of using robotic welding equipment? • What are the components of a robotic welding station?	• Cite advantages of using robotic welding equipment in manufacturing. • Identify the main parts of a robot and the components of a robotic welding station. • Describe the use of a teach pendant in programming a robot to perform its designated tasks. • Discuss the safety precautions to be taken when working around robots.	**Written** • Research Project on Robotic Welding • Self-Assessment **Performance** • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,5,6,7,8,11 **Cluster Standards** MN 1,2,5,6 **Pathway Standards** MN-PRO 1,3	**ELA** RI.9-10.1,2,4,8 W.9-10.1,2,4,6,7,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,4,7,8,9 WHST.9-10.1,2,4,6,7,8,9 **Math** **Science**
Week 39 **Welding in Industry** • Welder Certification (introduction)	• What codes and specifications are used to provide information on a required weld? • What is the difference between a procedure and a performance specification?	• Describe the use of codes and specifications to provide needed information on a required weld. • Discuss the difference between a welding procedure specification and a welding performance specification. • Explain why a welder often must pass a number welding performance qualifications. • List the steps that must be followed to conform to most codes. • List the things employers look for when hiring welders.	**Written** • Assignment on Welding Certification Process • Quiz on Different Welding Certifications • Self-Assessment **Performance** • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8,10,11 **Cluster Standards** MN 1,4,6 **Pathway Standards** MN-PRO 1	**ELA** RI.9-10.1,2,4 W.9-10.2,4,8,9 SL.9-10.1,2,4,6 L.9-10.1-6 **Literacy** RST.9-10.1,2,3,4,7,8,9 WHST.9-10.2,4,8,9 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 40 **Review** **Final Exam**	• What are the main learning goals for this past year in welding?	• Complete the written and performance assessments demonstrating a thorough knowledge of welding.	• Written and Performance Final Exam	**Career Ready Practices** CRP 2,4,6,8,11	**ELA** RI.9-10.1,2,4,7,8 W.9-10.2,4,6,8,9 SL.9-10.1,2,4,6 L.9-10.1-6
				Cluster Standards MN 1-6	**Literacy** RST.9-10.1,2,3,4,7,8,9 WHST.9-10.2,4,6,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science

Syracuse City School District
Career and Technical Education Program
Course Syllabus
WLD300: Welding 300

Pathway Overview

The Welding program is designed to give students a solid foundation in the knowledge and technical skills that will prepare them for positions as entry-level welders or for advanced placement in post-secondary education. The program provides students with the skills of arc welding, resistance welding, brazing and soldering, as well as cutting, heat-treating and metallurgy. Students will also gain knowledge of electrical systems, power sources and different welding technologies, welding systems, print interpretation and measurement, as well as the use and interpretation of visual symbols related to welding. Students will have the opportunity to intern at many local businesses as well as work on customer projects and design. Students who excel in this course will have the opportunity to work toward their Level 1–Entry Welder Certification through the American Welding Society (AWS).

Course Description

Students in the Welding 300 course will continue to study and become proficient in the equipment and techniques used for the welding processes most often used in today's industry including oxyfuel gas cutting and welding, Gas Metal Arc Welding (GMAW), Flux-Cored Arc Welding (FCAW), Shielded Metal Arc Welding (SMAW), and Gas Tungsten Arc Welding (GTAW), brazing and braze welding, soldering, resistance welding and robotic welding. Flat, horizontal, vertical, and overhead welding positions and basic joints, pipe, and tube welding will be practiced. Classroom instruction will also include career exploration in welding, safety, design, welding theory, math applications, advanced physics of welding, communication and organizational skills, welding symbols, inspecting and testing welds, and welder certification. As students become proficient in all welding areas, they will have the opportunity to work on customer projects and design.

Work-Based Learning

Students will be connected with welding professionals in the community through Career Coaching, field trips and job shadowing which could lead to further opportunities for direct job training and real-world experience. Students will create and maintain a portfolio of their work-based learning experiences throughout the program to document the development of their skills.

Additional Learning Opportunities

- **Micro-credentials:** Students may pursue learning experiences and credentials depending on the requirements of the projects that they are involved in. Some examples for this pathway include, but are not limited to:
    - OSHA 10 Construction Safety Certification
    - NABTU (North America's Building Trades Unions) Multi-Craft Core Curriculum (MC3)
    - Other relevant certifications as they become available through industry collaborations, teacher certifications and student interest.
- **Summer Bridge Enrichment:** Students will have the opportunity to participate in cross-curricular Summer Bridge programs to enhance and enrich their skills. Students will explore and create solutions that address authentic needs in the school and wider community with the involvement of local industry professionals. Students will build on skills learned during the school year to work collaboratively with students from other pathways and programs.

Pre-Requisites

WLD100: Welding 100 and WLD200: Welding 200

Course Objectives

1. Students will learn and practice the fundamentals of different types of welding processes.
2. Students will understand and apply safe working practices in a safe work environment.
3. Students will practice safe equipment set up, adjustment and tear down, and machine and tool maintenance.
4. Students will work as part of a team to clean up and care for equipment.

Integrated Academics

N/A

Equipment and Supplies

- **School will provide:** Welding helmet, safety glasses and shields, gloves, flame retardant jacket, apron, ear protection and dust mask when needed, lockers for work clothes, materials and welding consumables, tools, and machines
- **Student will provide:** Leather work boots or shoes (steel/composite toe preferred), long work pants with no holes that cover the top of the shoe or boot, pencil, notebook with paper, and folder with pockets

Textbook

Bowditch, W., Bowditch, K., & Bowditch, M. (2016). *Welding Fundamentals, 5th Edition.* Tinley Park, IL: Goodheart-Willcox.

Grading

50% Projects, Lab and Shop Work, Participation
25% Assignments
25% Quizzes and Exams

Additional Course Policies

Attendance will be counted towards the final grade in each marking period. All work, assignments or quizzes can be made up the following class until the last day of each marking period.

Course Calendar

Quarter	Units of Study

1	• Overview
	  ○ Class Expectations and Policies
	  ○ Careers in Welding
	  ○ Safety in the Welding Shop
	• Foundations
	  ○ Physics of Welding
	  ○ Math Applications for Welders
	  ○ Weld Joints and Positions
	  ○ Welding Symbols

2	• GMAW (MIG Welding) and FCAW
	  ○ Equipment and Supplies
	  ○ Equipment Assembly and Adjustment
	  ○ Flat Welding Position
	  ○ Horizontal, Vertical and Overhead Welding Positions
	• Oxyfuel Gas Processes
	  ○ Oxyfuel Gas Welding Flat Welding Position
	  ○ Oxyfuel Gas Welding Horizontal and Vertical Welding Positions
	  ○ Brazing and Braze Welding
	  ○ Soldering

3	• SMAW (Stick Welding)
	  ○ Equipment and Supplies
	  ○ Equipment Assembly and Adjustment
	  ○ Electrodes
	  ○ Horizontal, Vertical and Overhead Welding Positions
	  ○ Surfacing

4	• GTAW (TIG Welding)
	  ○ Equipment and Supplies
	  ○ Equipment Assembly and Adjustment
	  ○ Horizontal, Vertical and Overhead Welding Positions
	• Welding in Industry
	  ○ Special Welding and Cutting Processes
	  ○ Inspecting and Testing Welds
	  ○ Welder Certification
	• Review
	• Final Exam

Syracuse City School District
Career and Technical Education Program
Scope and Sequence
WLD 300: Welding 300

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Week 1 **Overview** • Class Expectations and Policies • Careers in Welding	• What are the expectations in the welding classroom and shop? • What factors should be considered when identifying personal career goals? • What jobs are available in the welding field? • What skills are needed for a successful welding career? • What are the steps to finding a welding-related job? • What behaviors does an employee need to keep and advance in a career? • What are the advantages and the disadvantages of becoming an entrepreneur?	• Discuss classroom expectations and policies. • Develop personal career goals. • Compile a list welding jobs available at various educational levels. • Discuss the different types of skills needed for a successful welding career. • Explain the steps and processes needed to find a welding-related job. • Elaborate on the actions needed to keep a job and advance in a career. • Compare the advantages and disadvantages of becoming an entrepreneur.	**Written** • Assignment on Careers in Welding Related Fields • Quiz on Class Expectations **Performance** • Teacher Observation of Class Expectations Checklist	**Career Ready Practices** CRP 2,4,7,10 **Cluster Standards** MN 1,4 **Pathway Standards** MN-PRO 4	**ELA** RI.11-12.1,2,4,10 W.11-12.2,4,8, 10 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,4,9 WHST.11-12.2,4,8 **Math** **Science**
Week 2 **Overview** • Safety in the Welding Shop	• Why is safety a priority in the welding shop? • What hazards are found in the welding shop? • What safety precautions should be in place to minimize the risk of injury? • What sources of safety information are necessary?	• Analyze the hazards that exist in the welding shop including fire hazards, machinery and tool hazards, fumes, and airborne contaminants. • Describe the methods used to minimize the risk of injury including appropriate clothing, PPE, machinery, and tool safety features. • Describe at least five general rules to follow when storing compressed gas. • Explain ways to prevent injury when lifting heavy objects. • Explain where to find information about welding on hazardous containers and disposing of hazardous waste legally and safely. • Understand the purpose of and where to find SDS documents.	**Written** • Assignment on Safety in the Workplace • Quiz on Safety • Research Project on Safety Hazards **Performance** • Safety Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,5,7,8,11,12 **Cluster Standards** MN 3,5,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.11-12.1,2,4 W.11-12.1,2,4,5,6,7,8,9 SL.11-12.1,2,4,5,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,4,9 WHST.11-12.1,2,4,7,8,9 **Math** **Science**
Weeks 3-6			**Written**	**Career Ready Practices**	**ELA**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Foundations • Physics of Welding • Math Applications for Welders	• Why is welding more efficient than riveting and machining? • What three methods are used to achieve a weld? • What happens to the size of base metal when it is heated? • What math applications are necessary for welders to know and use?	• Identify the three general methods by which a weld is achieved. • Summarize the difference between chemical and mechanical properties and give examples of each. • Experiment with the effects of welding on metal. • Discuss the processes used to heat-treat metal. • Compare the relationship between voltage and current. • Give examples of US customary and SI metric units of measurement. • Demonstrate knowledge and skills through application and projects. • Demonstrate converting fractions to decimals and decimals to fractions.	• Assignment on Heat Transfer and Physical Properties of Metal • Assignment on Converting Measurements • Quiz on Measurement Conversions **Performance** • Teacher Observation Checklist • Ruler Exercise: Finding Center Using a Ruler/Tape	CRP 2,4,8,11 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,5,7,9 WHST.11-12.2,4,8,9 **Math** **Science**
Weeks 7-8 **Foundations** • Weld Joints and Positions	• How are the five basic weld joints used in the field? • How does a welder decide which type of weld to use?	• Identify the five basic weld joints. • Discuss the types of welds that can be made on each joint. • Evaluate the parts of a fillet weld and a groove weld. • Model a stringer bead and a weave bead. • Model the four welding positions and evaluate the conditions needed for each.	**Written** • Assignment on Weld Joints and Angles • Quiz on Weld Joints • Self-Assessment **Performance** • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8 **Cluster Standards** MN 6 **Pathway Standards** MN-PRO 5	**ELA** RI.11-12.1,4,7 W.11-12.2,4,6 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,5,7,8 WHST.11-12.2,4,9 **Math** **Science**
Weeks 9-10 **Foundations** • Welding Symbols	• At what angle are the axes positioned to create an isometric drawing? • What does the welding symbol tell the welder?	• Make a mechanical drawing of a three-dimensional object using the orthographic projection process. • Cite the names of the views used in an orthographic projection. • Explain the characteristics of an isometric drawing. • Practice the basic types of welds indicated on the ANSI/AWS welding symbol. • Explain information on the weld symbol to determine the size of	**Written** • Assignment on Welding Symbols • Quiz on Welding Symbols • Research Project on How Welding Symbols Are Used • Self-Assessment **Performance** • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,7,8,11 **Cluster Standards** MN 6 **Pathway Standards** MN-PRO 5	**ELA** RI.11-12.1,4 W.11-12.2,4,8 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,3,4,7,9 WHST.11-12.2,4,9 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		the root opening, the groove angle, and the desired size, contour, and finish of the weld.			
Week 11 **GMAW (MIG Welding) and FCAW** • Equipment and Supplies • Equipment Assembly and Adjustment	• What is GMAW and what is it used for? • What are the advantages and disadvantages of GMAW and FCAW? • What equipment and gases are used for GMAW? • What are the main safety considerations when using GMAW? • How is a GMAW welding outfit assembled and adjusted?	• Discuss advantages and disadvantage of GMAW and FCAW. • Explain the correct polarity to use for GMAW and FCAW. • Demonstrate three methods of metal transfer. • Use the equipment that makes up a GMAW and FCAW outfit. • Explain the operation of a wire feeder. • Breakdown the parts of a welding gun and cables. • Describe four gases used for GMAW and identify the most common shielding gas used for FCAW. • Explain the use of a flowmeter for GMAW and FCAW. • Assemble a GMAW/FCAW welding outfit. • Adjust the drive mechanism for the proper pressure and alignment. • List the proper sequence for removing a bird's nest. • Adjust the shielding gas flowmeter for the proper pressure and flow rate. • Identify the electrode wire designations for GMAW and FCAW electrodes. • Identify the two adjustments that are made to the welding machine. • Use safety precautions for GMAW and FCAW.	**Written** • Assignment on GMAW and FCAW • Quiz on GMAW and FCAW • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.11-12.1,2,4 W.11-12.2,4,6,8,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,8,9 **Math** **Science**
Week 12-16 **GMAW (MIG Welding) and FCAW** • Flat Welding Position	• What are the advantages and disadvantages of GMAW and FCAW? • Which type of current is most commonly used for GMAW welding?	• Describe the advantages and disadvantages of GMAW and FCAW. • Determine the appropriate electrode to use with GMAW and FCAW.	**Written** • Assignment on GMAW vs. FCAW • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6	**ELA** RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,8,9

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
• Horizontal, Vertical and Overhead Welding Positions	• What factors must be considered before selecting the electrode and shielding gas? • What are the advantages of backhand welding over forehand welding? • What weld pool shape is used when welding a fillet weld in the vertical and overhead welding positions? • What two types of weld beads can be used to fill or build up a weld? • What type of protective clothing is recommended when welding in the overhead welding position?	• Explain four factors that a welder must consider before selecting the electrode and shielding gas. • Identify the correct electrode extension to use with GMAW and FCAW using different metal transfer methods. • Explain the uses of DCEN or DCEP currents for GMAW welding. • Set the correct shielding gas flow rate on the flowmeter. • Explain the effect of increasing the contact tube-to-work distance. • Explain two advantages of backhand welding over forehand welding. • Describe the weld pool shape used when welding a fillet weld in the vertical and overhead welding positions. • Describe two types of weld beads that can be used to fill or build up a weld. • Analyze why flat position welding is preferred over out-of-position welding. • Demonstrate the correct welding gun angle for out-of-position welding. • Explain the type of protective clothing needed when welding in the overhead welding position. • Weld in the flat, horizontal, vertical, and overhead welding positions using GMAW and FCAW. • Identify various weld defects. • Demonstrate knowledge and skills through application and projects.	• Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Pathway Standards** MN-PRO 1-5	**Math** **Science**
Week 17 **Oxyfuel Gas Processes:**	• How are welds made using an oxyfuel gas welding outfit?	• Practice the four positions used in welding and explain which is the most efficient.	**Written** • Assignment on Welding Gases • Quiz on Different Gases Used in Welding	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12	**ELA** RI.11-12.1,2,4 W.11-12.2,4,9 SL.11-12.1,2,4,6 L.11-12.1-6

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
• Oxyfuel Gas Welding Flat Welding Position	• What weld angles are used for welding in the flat position?	• Discuss the proper protective clothing that must be worn for oxyfuel gas cutting or welding. • Distinguish how to hold a torch for both forehand and backhand welding. • Determine the torch angles used to weld in the flat position. • Examine a weld pool along a weld joint. • Weld edge, corner, and flanged butt joints without a welding rod. • Select a welding rod. • Lay a weld bead on a plate using a welding rod. • Lay a fillet weld on lap and T-joints using a welding rod. • Weld a butt joint using a welding rod. • Evaluate welds and identify weld defects.	• Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,8,9 **Math** **Science**
Week 18 **Oxyfuel Gas Processes:** • Oxyfuel Gas Welding Horizontal and Vertical Welding Positions	• Why is out-of-position welding sometimes necessary? • What safety measures need to be taken when welding out of position?	• Explain why out-of-position welding sometimes necessary. • Identify safety measures to be taken when welding out of position. • Describe methods used to perform welds in the horizontal and vertical welding positions. • Weld in the horizontal and vertical welding positions with oxyfuel gas welding (OFW). • Evaluate welds and identify weld defects.	**Written** • Assignment on Oxyfuel and Its Uses on the Job Site • Quiz on Oxyfuel Welding • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.11-12.1,2,4 W.11-12.2,4,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,8,9 **Math** **Science**
Week 19 **Oxyfuel Gas Processes** • Brazing and Braze Welding	• What is the difference between brazing and braze welding? • How are brazing filler metals chosen? • How is a joint prepared for brazing or braze welding? • How does a welder choose the correct equipment for brazing and braze welding? • What safety precautions are necessary for brazing and braze welding?	• Explain the major difference between the brazing and braze welding processes. • Explain the available brazing filler metals and evaluate the factors to be considered when choosing a filler metal. • Demonstrate the proper procedure for cleaning a joint prior to brazing or braze welding. • Choose the correct torch tip, rod diameter, and flux for brazing and braze welding.	**Written** • Assignment on Purpose and Conditions for Brazing • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.11-12.1,2,4 W.11-12.2,4,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,8,9 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
	• What makes a good braze weld?	• Model safety precautions for brazing and braze welding. • Demonstrate the procedures for brazing and braze welding. • Evaluate welds and identify weld defects in both the flat position and out of position.			
Week 20 **Oxyfuel Gas Processes** • Soldering	• What are the principles of soldering? • What are the advantages and disadvantages of soldering? • How does a welder choose the correct filler metals and fluxes for different types of soldering work? • What are the proper steps and safety precautions for soldering?	• Explain the principles of soldering. • Debate the advantages and disadvantages of soldering. • Explain the purposes and classifications of soldering fluxes. • Choose the appropriate filler metal and flux for soldering. • Describe common hazards associated with lead-containing solders and fluxes. • Identify acceptable solders for drinking water systems. • Practice the soldering process, including the steps needed to clean metal surfaces prior to soldering. • Explain safety precautions and be aware of potential health hazards related to soldering. • Model soldering lap and pipe joints.	**Written** • Assignment on Soldering and Heat Transfer • Quiz on Soldering and Heat Transfer • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.11-12.1,2,4 W.11-12.2,4,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,8,9 **Math** **Science**
Week 21 **SMAW (Stick Welding)** • Equipment and Supplies • Equipment Assembly and Adjustment	• What equipment is found in a SMAW station? • How is the SMAW station prepared for work? • What safety precautions should be considered when setting up a SMAW station?	• Identify the components of an arc welding outfit and arc welding station. • Describe factors to consider when selecting an arc welding machine. • Demonstrate the differences between direct current (DC) and alternating current (AC). • Use American Welding Society (AWS) abbreviations regarding welding current polarity. • Explain the safety precautions that need to be considered when setting up a SMAW station. • Demonstrate safe and proper use of the SMAW equipment and accessories.	**Written** • Assignment on Setting Up SMAW Outfit • Quiz on Parts of a SMAW Outfit • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation	**Career Ready Practices** CRP 2,4,8 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,8,9 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		• Demonstrate knowledge and skills through application and projects.			
Week 22 **SMAW (Stick Welding)** • Electrodes	• What information does the AWS electrode identification system provide? • What are the purposes of an electrode covering? • Why should electrodes be kept in their shipping containers until they are used? • How does a welder decide what electrode to use in different conditions?	• Explain six purposes of an electrode covering. • Use the AWS electrode identification system. • Model two means of storing electrodes. • Distinguish between carbon and low alloy SMAW electrodes. • Determine the trial amperage of a welding machine using the rule-of-thumb method. • Choose an electrode to meet the requirements of a weld. • List three advantages of using smaller diameter electrodes for out-of-position welding.	**Written** • Assignment on SMAW Electrodes • Quiz on Electrodes • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8,11 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.11-12.1,4 W.11-12.2,4,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,3,4,7,9 WHST.11-12.2,4,9 **Math** **Science**
Weeks 23-29 **SMAW (Stick Welding)** • Horizontal, Vertical and Overhead Welding Positions	• Why is it advisable to wear earplugs for out-of-position welding? • What protective clothing should be worn for out-of-position welding? • What methods are used to strike an SMAW arc?	• Use the proper protective clothing when welding out of position. • Weld in the horizontal and vertical welding positions. • Predict the procedure for welding uphill and downhill. • Weld in the overhead welding position. • Evaluate welds and identify weld defects. • Demonstrate knowledge and skills through application and projects.	**Written** • Assignment on SMAW Welds and Positions: When to Use Each • Quiz on SMAW Welding Positions • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,7,8,9 **Math** **Science**
Week 30 **SMAW (Stick Welding)** • Surfacing	• When does a part need surfacing? • What processes are used for surfacing a part? • How are materials tested for hardness? • How does a welder choose the correct electrode for surfacing a part?	• List reasons for surfacing a part. • Identify the various surfacing processes. • List reasons for wear that occurs in parts. • Define characteristics of surfacing electrodes. • List two means of testing material hardness. • Describe abbreviations used when specifying surfacing electrodes.	**Written** • Assignment on Surfacing Processes • Quiz on Surfacing and Surfacing Electrodes • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,8,9 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		• Select the proper surfacing electrode and surface a part.			
Week 31 **GTAW (TIG Welding)** • Equipment and Supplies • Equipment Assembly and Adjustment	• What is GTAW? • Why is a post flow of shielding gas used with GTAW? • What type of connection is used for shielding gas and water hoses? • What are the major types of electrodes used in GTAW? • What type of current requires the high-frequency voltage to be used continuously? • What are the two ways to increase the current while welding?	• Explain the principles of GTAW. • Describe and demonstrate the equipment and supplies involved with GTAW. • Break down the parts of a GTAW torch. • List three of the major types of electrodes used in GTAW. • Explain the functions of the cables and hoses in GTAW. • Describe the direction of the grind marks go when grinding an electrode. • List two ways to strike, or start, an arc. • Describe the ways to increase the current when welding. • Discuss safety considerations when gas tungsten arc welding. • Demonstrate knowledge and skills through application and projects.	**Written** • Assignment on Setting Up a GTAW Outfit • Quiz on Equipment Used During GTAW Welding • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 2,3,4,8,11 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,7,8,9 WHST.11-12.2,4,8,9 **Math** **Science**
Weeks 32-37 **GTAW (TIG Welding)** • Horizontal, Vertical and Overhead Welding Positions	• What safety precautions should a welder take to prevent being burned by falling molten metal? • What are three common defects that occur when welding in the horizontal position?	• Explain why out-of-position welding is often an important part of welder qualification tests. • Select the correct torch and welding rod angles for out-of-position welding. • Practice welding in the horizontal, vertical, and overhead welding positions with GTAW. • Evaluate welds and identify weld defects. • Demonstrate knowledge and skills through application and projects.	**Written** • Assignment on GTAW Welding Proper Techniques and Positions • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 1-5	**ELA** RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,7,8,9 WHST.11-12.2,4,7,8,9 **Math** **Science**
Week 38 **Welding in Industry** • Special Welding and Cutting Processes	• What special welding and cutting processes are used in industry?	• Identify several special welding processes used in industry for unusual metals or unusual positions. • Describe several special cutting processes used in industry. • Evaluate the advantages of some special welding and cutting	**Written** • Assignment on Special Welding and Cutting Processes • Research Project on Special Welding and Cutting Processes • Self-Assessment	**Career Ready Practices** CRP 2,4,8,11 **Cluster Standards** MN 1 **Pathway Standards**	**ELA** RI.11-12.1,2,4,8 W.11-12.2,4,6,7,8,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,7,8,9 WHST.11-12.1,2,4,6,7,8,9 **Math**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		processes that are used in industry. • Demonstrate knowledge and skills through application and projects	**Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	MN-PRO 5	**Science**
Week 39 **Welding in Industry** • Inspecting and Testing Welds	• What is the difference between a flaw and a defect? • What are the most common types of tests done on welds?	• Explain the difference between a welding flaw and a welding defect. • List the most common types of nondestructive and destructive testing done on welds. • Describe the methods used to prepare samples for tensile bend tests. • Perform several basic types of tests on welds to evaluate weld quality.	**Written** • Assignment on Identifying Flaws in a Weld • Quiz on Weld Flaw Identification • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12	**ELA** RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6 L.11-12.1-6
				Cluster Standards MN 3,4,5,6	**Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,7,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science
Week 40 **Welding in Industry** • Welder Certification **Review** **Final Exam**	• What codes and specifications are used to provide information on a required weld? • What is the difference between a procedure and a performance specification? • What are the main learning goals for this past year in welding?	• Describe the codes and specifications that provide needed information on a required weld. • Compare the difference between a welding procedure specification and a welding performance specification. • Justify why a welder often must pass a number welding performance qualifications. • Utilize the steps that must be followed to conform to most codes. • Describe the things employers look for when hiring welders. • Complete the written and performance assessments demonstrating a thorough knowledge of welding.	**Written** • Assignment on Welding Certification Process • Quiz on Different Welding Certifications • Self-Assessment • Written Final Exam **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Performance Final Exam	**Career Ready Practices** CRP 2,4,6,8,10,11	**ELA** RI.11-12.1,2,4,7,8 W.11-12.2,4,6,8,9 SL.11-12.1,2,4,6 L.11-12.1-6
				Cluster Standards MN 1-6	**Literacy** RST.11-12.1,2,3,4,7,8,9 WHST.11-12.2,4,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science

Syracuse City School District
Career and Technical Education Program
Course Syllabus
WLD400: Welding 400

Pathway Overview

The Welding program is designed to give students a solid foundation in the knowledge and technical skills that will prepare them for positions as entry-level welders or for advanced placement in post-secondary education. The program provides students with the skills of arc welding, resistance welding, brazing and soldering, as well as cutting, heat-treating and metallurgy. Students will also gain knowledge of electrical systems, power sources and different welding technologies, welding systems, print interpretation and measurement, as well as the use and interpretation of visual symbols related to welding. Students will have the opportunity to intern at many local businesses as well as work on customer projects and design. Students who excel in this course will have the opportunity to work toward their Level 1–Entry Welder Certification through the American Welding Society (AWS).

Course Description

Students in the Welding 400 course will continue to study and begin to master the equipment and techniques used for the welding processes most often used in today's industry including oxyfuel gas cutting and welding, Gas Metal Arc Welding (GMAW), Flux-Cored Arc Welding (FCAW), Shielded Metal Arc Welding (SMAW), and Gas Tungsten Arc Welding (GTAW), brazing and braze welding, soldering, resistance welding and robotic welding. Flat, horizontal, and vertical welding positions and basic joints, pipe, and tube welding will be practiced. Classroom instruction will also include career exploration in welding, safety, design, welding theory, math applications, advanced physics of welding, communication and organizational skills, welding symbols, inspecting and testing welds, preparation for welder certification, and local internships in welding. As students become proficient in all welding areas, they will have the opportunity to work on customer projects and design.

Work-Based Learning

Students will be connected with welding professionals in the community through Career Coaching, field trips and job shadowing which could lead to further opportunities for direct job training and real-world experience. Students will create and maintain a portfolio of their work-based learning experiences throughout the program to document the development of their skills.

Additional Learning Opportunities

- **Micro-credentials:** Students may pursue learning experiences and credentials depending on the requirements of the projects that they are involved in. Some examples for this pathway include, but are not limited to:
    - OSHA 10 Construction Safety Certification
    - NABTU (North America's Building Trades Unions) Multi-Craft Core Curriculum (MC3)
    - Other relevant certifications as they become available through industry collaborations, teacher certifications and student interest.
- **Summer Bridge Enrichment:** Students will have the opportunity to participate in cross-curricular Summer Bridge programs to enhance and enrich their skills. Students will explore and create solutions that address authentic needs in the school and wider community with the involvement of local industry professionals. Students will build on skills learned during the school year to work collaboratively with students from other pathways and programs.

Pre-Requisites

WLD100: Welding 100, WLD200: Welding 200 and WLD300: Welding 300

Course Objectives

1. Students will learn and practice the fundamentals of different types of welding processes.
2. Students will understand and apply safe working practices in a safe work environment.
3. Students will practice safe equipment set up, adjustment and tear down, and machine and tool maintenance.
4. Students will work as part of a team to clean up and care for equipment.

Integrated Academics

N/A

Equipment and Supplies

- **School will provide:** Welding helmet, safety glasses and shields, gloves, flame retardant jacket, apron, ear protection and dust mask when needed, lockers for work clothes, materials and welding consumables, tools, and machines
- **Student will provide:** Leather work boots or shoes (steel/composite toe preferred), long work pants with no holes that cover the top of the shoe or boot, pencil, notebook with paper, and folder with pockets

Textbook

Bowditch, W., Bowditch, K., & Bowditch, M. (2016). *Welding Fundamentals, 5th Edition.* Tinley Park, IL: Goodheart-Willcox.

Grading

50% Projects, Lab and Shop Work, Participation
25% Assignments
25% Quizzes and Exams

Additional Course Policies

Attendance will be counted towards the final grade in each marking period. All work, assignments or quizzes can be made up the following class until the last day of each marking period.

Course Calendar

Quarter	Units of Study

1	• Overview
	  ○ Class Expectations and Policies
	  ○ Careers in Welding
	  ○ Safety in the Welding Shop
	• Foundations
	  ○ Physics of Welding
	  ○ Weld Joints and Positions
	  ○ Welding Symbols

2	• GMAW (MIG Welding) and FCAW
	  ○ Flat, Horizontal, Vertical and Overhead Welding Positions
	• Oxyfuel Gas Processes
	  ○ Oxyfuel Gas Welding Horizontal and Vertical Welding Positions
	  ○ Brazing and Braze Welding

3	• SMAW (Stick Welding) ○ Flat, Horizontal, Vertical and Overhead Welding Positions

4	• GTAW (TIG Welding)
	  ○ Horizontal, Vertical and Overhead Welding Positions
	• Welding in Industry
	  ○ Internships
	  ○ Welder Certification
	• Review
	• Final Exam

Syracuse City School District
Career and Technical Education Program
Scope and Sequence
WLD 400: Welding 400

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
Weeks 1-2 **Overview** • Class Expectations and Policies • Careers in Welding	• What are the expectations in the welding classroom and shop? • What factors should be considered when identifying personal career goals? • What jobs are available in the welding field? • What skills are needed for a successful welding career? • What are the steps to finding a welding-related job? • What behaviors does an employee need to keep and advance in a career? • What are the advantages and the disadvantages of becoming an entrepreneur?	• Discuss classroom expectations and policies. • Explain several factors to be considered when developing personal career goals. • Determine which welding jobs available at various educational levels. • Support an opinion on the different types of skills needed for a successful welding career. • Interpret the steps and processes needed to find a welding-related job. • Defend what actions are needed to keep a job and advance in a career. • Prioritize the advantages and disadvantages of becoming an entrepreneur. • Demonstrate knowledge and skills through application and projects.	**Written** • Assignment on Careers in Welding Related Fields • Quiz on Class Expectations **Performance** • Teacher Observation of Class Expectations Checklist	**Career Ready Practices** CRP 2,4,7,10 **Cluster Standards** MN 1,4 **Pathway Standards** MN-PRO 4	**ELA** RI.11-12.1,2,4,10 W.11-12.2,4,8, 10 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,4,9 WHST.11-12.2,4,8 **Math** **Science**
Week 3 **Overview** • Safety in the Welding Shop	• Why is safety a priority in the welding shop? • What hazards are found in the welding shop? • What safety precautions should be in place to minimize the risk of injury? • What sources of safety information are necessary?	• Discuss the hazards that exist in the welding shop. • Determine the clothing items that should be worn when welding or cutting. • Predict the various causes of fire hazards. • Explain the machinery and tool hazards present in a welding shop and the safety features that can be used in an emergency. • Dispute the danger of fumes and airborne contaminants to the welder and the safety precautions that provide respiratory protection. • Cite at least five general rules to follow when storing compressed gas.	**Written** • Assignment on Safety in the Workplace • Quiz on Safety • Research Project on Safety Hazards **Performance** • Safety Checklist • Teacher Observation Checklist	**Career Ready Practices** CRP 1,2,3,4,5,7,8,11,12 **Cluster Standards** MN 3,5,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.11-12.1,2,4 W.11-12.1,2,4,5,6,7,8,9 SL.11-12.1,2,4,5,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,4,9 WHST.11-12.1,2,4,7,8,9 **Math** **Science**

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
		• List ways to prevent injury when lifting heavy objects. • Describe hazards present in specific areas of the welding shop and the methods used to minimize the risk of injury. • Support where to find information about welding on hazardous containers and disposing of hazardous waste legally and safely. • Elaborate the purpose of and where to find SDS documents. • Demonstrate knowledge and skills through application and projects.			
Weeks 4-5 **Foundations** • Physics of Welding	• Why is welding more efficient than riveting and machining? • What three methods are used to achieve a weld? • What happens to the size of base metal when it is heated?	• Model the three general methods by which a weld is achieved. • Describe the difference between chemical and mechanical properties and give examples of each. • Predict the effects of welding on metal. • Demonstrate the processes used to heat-treat metal. • Discuss the relationship between voltage and current. • Make up examples of US customary and SI metric units of measurement.	**Written** • Assignment on Heat Transfer and Physical Properties of Metal • Assignment on Converting Measurements • Quiz on Measurement Conversions **Performance** • Teacher Observation Checklist • Ruler Exercise: Calculating Center Using a Ruler/Tape	**Career Ready Practices** CRP 2,4,8,11 **Cluster Standards** MN 3,6 **Pathway Standards** MN-PRO 2,5	**ELA** RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,5,7,9 WHST.11-12.2,4,8,9 **Math** **Science**
Weeks 6-10 **Foundations** • Weld Joints and Positions • Welding Symbols	• How are the five basic weld joints used in the field? • How does a welder decide which type of weld to use? • At what angle are the axes positioned to create an isometric drawing? • What does the welding symbol tell the welder? • How is a blueprint or schema interpreted?	• Model the four welding positions and evaluate the conditions needed for each. • Use information on the weld symbol to determine the size of the root opening, the groove angle, and the desired size, contour, and finish of the weld. • Explain the varied dimensional views of an object. • Demonstrate accurate interpretation of a blueprint or schema in regards to welding. • Demonstrate knowledge and skills through application and projects.	**Written** • Assignment on Weld Joints, Angles, and Welding Symbols • Quiz on Welding Symbols • Self-Assessment **Performance** • Teacher Observation Checklist	**Career Ready Practices** CRP 2,4,8 **Cluster Standards** MN 6 **Pathway Standards** MN-PRO 5	**ELA** RI.11-12.1,4,7 W.11-12.2,4,6,8 SL.11-12.1,2,4,6 L.11-12.1-6 **Literacy** RST.11-12.1,2,3,4,5,7,8 WHST.11-12.2,4,9 **Math** **Science**
Weeks 11-16	• What makes a good weld?	• Weld in the flat, horizontal, vertical, and overhead welding positions using GMAW and FCAW.	**Written** • Assignment on GMAW vs. FCAW	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12	**ELA** RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
GMAW (MIG Welding) and FCAW • Flat, Horizontal, Vertical and Overhead Welding Positions	• What type of protective clothing is strongly recommended when welding in the overhead welding position? • What is the difference between a flaw and a defect? • What are the most common types of tests done on welds?	• Evaluate welds and identify weld defects. • Demonstrate knowledge and skills through application and projects.	• Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test		L.11-12.1-6
				Cluster Standards MN 3,6	**Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science
Weeks 17-20 **Oxyfuel Gas Processes:** • Oxyfuel Gas Welding Horizontal and Vertical Welding Positions • Brazing and Braze Welding	• What safety measures need to be taken when welding out of position? • What safety precautions are necessary for brazing and braze welding? • What makes a good braze weld? • What is the difference between a flaw and a defect? • What are the most common types of tests done on welds?	• Apply safety measures when welding out of position. • Weld in the horizontal and vertical welding positions with oxyfuel gas welding (OFW). • Model safety precautions for brazing and braze welding. • Demonstrate the procedures for brazing and braze welding. • Evaluate welds and identify weld defects. • Demonstrate knowledge and skills through application and projects.	**Written** • Assignment on Oxyfuel Welding and Brazing Applications • Quiz on Oxyfuel Welding and Brazing • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12	**ELA** RI.11-12.1,2,4 W.11-12.2,4,9 SL.11-12.1,2,4,6 L.11-12.1-6
				Cluster Standards MN 3,6	**Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science
Weeks 21-30 **SMAW (Stick Welding)** • Flat, Horizontal, Vertical and Overhead Welding Positions	• What protective clothing should be worn for out-of-position welding? • What makes a good weld? • What is the difference between a flaw and a defect? • What are the most common types of tests done on welds?	• Use the proper protective clothing when welding out of position. • Weld in the flat, horizontal, vertical, and overhead welding positions. • Evaluate welds and identify weld defects. • Demonstrate knowledge and skills through application and projects.	**Written** • Assignment on SMAW Welds and Positions: When to Use Each • Quiz on SMAW Welding Positions • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12	**ELA** RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6 L.11-12.1-6
				Cluster Standards MN 3,6	**Literacy** RST.11-12.1,2,3,4,7,9 WHST.11-12.2,4,7,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science
Weeks 31-33 **GTAW (TIG Welding)**	• What safety precautions should a welder take to	• Investigate why out-of-position welding is often an important part of welder qualification tests.	**Written**	**Career Ready Practices** CRP 1,2,3,4,6,8,11,12	**ELA** RI.11-12.1,2,4 W.11-12.2,4,8,9 SL.11-12.1,2,4,6

Time Frame Unit of Study	Key Questions	Key Learning Targets (Students will know and be able to)	Assessment Evidence of Learning	CCTC Standards	NYS Standards
• Horizontal, Vertical, and Overhead Welding Positions	prevent being burned by falling molten metal? • What is the difference between a flaw and a defect? • What are the most common types of tests done on welds?	• Model the correct torch and welding rod angles for out-of-position welding. • Evaluate welds in the horizontal, vertical, and overhead welding positions with GTAW. • Demonstrate knowledge and skills through application and projects.	• Assignment on GTAW Welding Proper Techniques and Positions • Self-Assessment **Performance** • Safety Checklist • Procedure Checklist • Teacher Observation Checklist • Welding Rating Rubric • Welding Coupon Preparation • Welding Joint Bend Test		L.11-12.1-6
				Cluster Standards MN 3,6	**Literacy** RST.11-12.1,2,3,4,7,8,9 WHST.11-12.2,4,7,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science
Weeks 34-40 **Welding in Industry** • Internships • Welder Certification **Review** **Final Exam**	• How does an employee convey professionalism in the workplace? • How do professionals work together to solve problems? • What codes and specifications are used to provide information on a required weld? • What is the difference between a procedure and a performance specification? • What are the main learning goals for this past year in welding?	• Apply the knowledge and skills learned in the classroom to working in a professional setting. • Explain how various professionals work together toward the common goal of solving problems. • Explain how the demands of a job can change according to the setting and the needs of the employer. • Explain and demonstrate professionalism and ethics in the workplace. • Complete internship requirements. • Prepare for Welding Certification performance tests. • Obtain AWS Certification. • Complete the written and performance assessments demonstrating a thorough knowledge of welding.	**Written** • Internship Report • Self-Assessment • AWS Certification Test • Written Final Exam **Performance** • AWS Certification Test • Performance Final Exam	**Career Ready Practices** CRP 2,4,6,8,10,11	**ELA** RI.11-12.1,2,4,7,8 W.11-12.2,4,6,8,9 SL.11-12.1,2,4,6 L.11-12.1-6
				Cluster Standards MN 1-6	**Literacy** RST.11-12.1,2,3,4,7,8,9 WHST.11-12.2,4,8,9
				Pathway Standards MN-PRO 1-5	**Math**
					Science