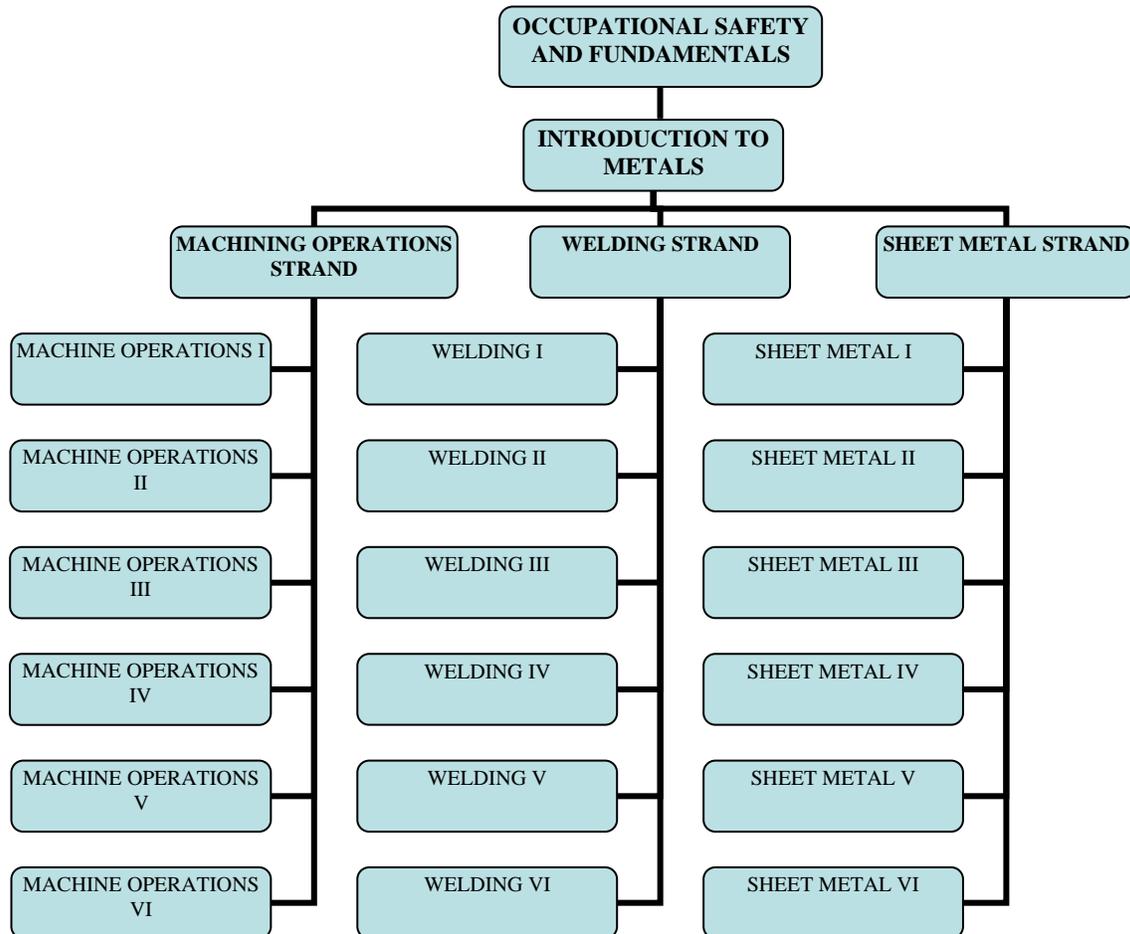


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METALS TECHNOLOGY PATHWAY MAP



This Metals Technology Pathway is designed to prepare a student with foundational knowledge and skills for a career in one of three possible crafts. As the student progresses through the Pathway they are given the opportunity to explore three craft areas on an introductory level. Once they have completed the foundational and introductory levels they are then given the option to “major” in at least one of three craft areas. These areas are Machining Operations, Welding, or Sheet Metal. Successful completion of this Pathway includes four units consisting of Occupational Safety and Fundamentals; Introduction to Metals; and Levels I and II within one craft area.

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PROGRAM CONCENTRATION: Architecture, Construction,
Communications & Transportation
CAREER PATHWAY: METALS TECHNOLOGY
COURSE TITLE: Occupational Safety and Fundamentals

This course is the foundational course that prepares students for a pursuit of any career in the field of construction. It prepares the trainee for the basic knowledge to function safely on or around a construction site and in the industry in general. It provides the trainee with the option for an Industry Certification in the Construction Core.

This course explains the safety obligations of workers, supervisors, and managers to ensure a safe workplace. Course content discusses the causes and results of accidents and the dangers of rationalizing risks. It includes the basic content of OSHA 10-hour safety standards. It also includes the basic knowledge and skills needed in the following areas: construction math, hand and power tools used in the field, general blueprints, and basics of rigging safety.

ACCT -OS-1 Students will understand and practice construction safety.

- a. Demonstrate knowledge of use and care of PPE.
- b. Demonstrate a basic knowledge of OSHA and its regulations.
- c. Demonstrate a basic knowledge of safety as related to aerial work, electricity, and fire.

Academic Standards:

MA1P4. Students will make connections among mathematical ideas and to other disciplines.

- a. *Recognize and use connections among mathematical ideas.*
- b. *Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.*
- c. *Recognize and apply mathematics in contexts outside of mathematics.*

SSCG15. The student will explain the functions of the departments and agencies of the federal bureaucracy.

- a. *Compare and contrast the organization and responsibilities of independent regulatory agencies, government corporations, and executive agencies.*
- b. *Explain the functions of the Cabinet.*

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ELA9RC3. The student acquires new vocabulary in each content area and uses it correctly.

- a. Demonstrates an understanding of contextual vocabulary in various subjects.*
- b. Uses content vocabulary in writing and speaking.*
- c. Explores understanding of new words found in subject area texts.*

ACCT -OS-2 Students will understand and apply math concepts as applied to construction.

- a. Demonstrate knowledge and application of measuring.
- b. Demonstrate ability to apply basic math computations to construction settings.
- c. Apply basic geometric calculations including the 3-4-5 rule.
- d. Demonstrate knowledge and application of area and volume calculations.

Academic Standards:

MA1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.*
- b. Determine the distance between a point and a line.*
- c. Determine the midpoint of a segment.*
- d. Understand the distance formula as an application of the Pythagorean theorem.*

MM1P1. Students will solve problems (using appropriate technology).

- a. Build new mathematical knowledge through problem solving.*
- b. Solve problems that arise in mathematics and in other contexts.*
- c. Apply and adapt a variety of appropriate strategies to solve problems.*
- d. Monitor and reflect on the process of mathematical problem solving.*

MM1P3. Students will communicate mathematically.

- a. Organize and consolidate their mathematical thinking through communication.*
- b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.*
- c. Analyze and evaluate the mathematical thinking and strategies of others.*

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d. Use the language of mathematics to express mathematical ideas precisely.

MM1P4. Students will make connections among mathematical ideas and to other disciplines.

- a. Recognize and use connections among mathematical ideas.*
- b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.*
- c. Recognize and apply mathematics in contexts outside of mathematics.*

MM2G1. Students will identify and use special right triangles.

- a. Determine the lengths of sides of 30°-60°-90° triangles.*
- b. Determine the lengths of sides of 45°-45°-90° triangles.*

MM2G2. Students will define and apply sine, cosine, and tangent ratios to right triangles.

- a. Discover the relationship of the trigonometric ratios for similar triangles.*
- b. Explain the relationship between the trigonometric ratios of complementary angles.*
- c. Solve application problems using the trigonometric ratios.*

MM2A4. Students will solve quadratic equations and inequalities in one variable.

- c. Analyze the nature of roots using technology and using the discriminant.*

MM2G3. Students will understand the properties of circles.

- d. Justify measurements and relationships in circles using geometric and algebraic properties.*

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.*
- b. Determine the distance between a point and a line.*
- c. Determine the midpoint of a segment.*
- d. Understand the distance formula as an application of the Pythagorean theorem.*

ELA9W3. The student uses research and technology to support writing.

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- b. Uses supporting evidence from multiple sources to develop the main ideas within the body of an essay, composition, or technical document.*
- c. Synthesizes information from multiple sources and identifies complexities and discrepancies in the information and the different perspectives found in each medium (i.e., almanacs, microfiche, news sources, in-depth field studies, speeches, journals, or technical documents).*

ACCT -OS-3 Students will use basic hand and power tools in a professional and safe manner.

- a. Demonstrate knowledge of rules and regulations regarding the safe use of hand and power tools.
- b. Demonstrate knowledge of the care and maintenance of hand and power tools.
- c. Demonstrate the knowledge of proper usage techniques of hand and power tools.

Academic Standards:

SSCG15. The student will explain the functions of the departments and agencies of the federal bureaucracy.

- a. Compare and contrast the organization and responsibilities of independent regulatory agencies, government corporations, and executive agencies.*

ELA9LSV1. The student participates in student-to-teacher, student-to-student, and group verbal interactions.

- b. Asks relevant questions.*
- c. Responds to questions with appropriate information.*
- d. Actively solicits another person's comments or opinions.*
- f. Volunteers contributions and responds when directly solicited by teacher or discussion leader.*
- g. Gives reasons in support of opinions expressed.*
- i. Employs group decision-making techniques such as brainstorming or a problem-solving sequence (i.e., recognizes problem, defines problem, identifies possible solutions, selects optimal solution, implements solution, and evaluates solution).*
- j. Divides labor to achieve the overall group goal efficiently.*

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ACCT -OS-4 Students will be introduced to blueprint terms, components, and symbols.

- a. Demonstrate knowledge of blueprint terms.
- b. Demonstrate knowledge of blueprint components.
- c. Demonstrate knowledge of blueprint symbols.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. *Determine the distance between two points.*
- b. *Determine the distance between a point and a line.*
- c. *Determine the midpoint of a segment.*
- d. *Understand the distance formula as an application of the Pythagorean theorem.*
- e. *Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.*

MM1P3. Students will communicate mathematically.

- a. *Organize and consolidate their mathematical thinking through communication.*
- b. *Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.*
- c. *Analyze and evaluate the mathematical thinking and strategies of others.*
- d. *Use the language of mathematics to express mathematical ideas precisely.*

MM1P4. Students will make connections among mathematical ideas and to other disciplines.

- a. *Recognize and use connections among mathematical ideas.*
- b. *Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.*
- c. *Recognize and apply mathematics in contexts outside of mathematics.*

SSCG18. The student will demonstrate knowledge of the powers of Georgia's state and local governments.

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- a. *Examine the powers of state and local government.*
- c. *Analyze the services provided by state and local government.*

ELA9RL5. Student understands and acquires new vocabulary and uses it correctly in reading and writing.

- a. *Uses general dictionaries, specialized dictionaries, thesauruses, or related references as needed to increase learning.*

ELA9RC3. The student acquires new vocabulary in each content area and uses it correctly.

- a. *Demonstrates an understanding of contextual vocabulary in various subjects.*
- b. *Uses content vocabulary in writing and speaking.*
- c. *Explores understanding of new words found in subject area texts.*

ELA9W3. The student uses research and technology to support writing.

- b. *Uses supporting evidence from multiple sources to develop the main ideas within the body of an essay, composition, or technical document.*
- c. *Synthesizes information from multiple sources and identifies complexities and discrepancies in the information and the different perspectives found in each medium (i.e., almanacs, microfiche, news sources, in-depth field studies, speeches, journals, or technical documents).*

ACCT -OS-5 Students will explain and implement safe rigging procedures.

- a. *Demonstrate the knowledge of basic rigging equipment.*
- b. *Demonstrate the knowledge of basic rigging communication.*
- c. *Demonstrate the knowledge of basic rigging safety.*

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. *Determine the distance between two points.*
- b. *Determine the distance between a point and a line.*
- c. *Determine the midpoint of a segment.*
- d. *Understand the distance formula as an application of the Pythagorean theorem.*

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- e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.*

MM1P3. Students will communicate mathematically.

- a. Organize and consolidate their mathematical thinking through communication.*
- b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.*
- c. Analyze and evaluate the mathematical thinking and strategies of others.*
- d. Use the language of mathematics to express mathematical ideas precisely.*

MM1P4. Students will make connections among mathematical ideas and to other disciplines.

- a. Recognize and use connections among mathematical ideas.*
- b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.*
- c. Recognize and apply mathematics in contexts outside of mathematics.*

SSCG15. The student will explain the functions of the departments and agencies of the federal bureaucracy.

- a. Compare and contrast the organization and responsibilities of independent regulatory agencies, government corporations, and executive agencies.*

SSCG18. The student will demonstrate knowledge of the powers of Georgia's state and local governments.

- a. Examine the powers of state and local government.*
- c. Analyze the services provided by state and local government.*

ELA9RL5. Student understands and acquires new vocabulary and uses it correctly in reading and writing.

- c. Uses general dictionaries, specialized dictionaries, thesauruses, or related references as needed to increase learning.*

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ELA9C1. The student demonstrates understanding and control of the rules of the English language, realizing that the usage involves appropriate applications of conventions and grammar in both written and spoken formats.

- a. Demonstrates an understanding of proper English usage and control of grammar, sentence and paragraph structure, diction, and syntax.*
- c. Demonstrates an understanding of sentence construction (i.e., subordination, proper placement of modifiers) and proper English usage (i.e., consistency of verb tenses).*

SP1. Students will analyze the relationships between force, mass, gravity, and the motion of objects.

- e. Measure and calculate the magnitude of gravitational forces.*
- h. Determine the conditions required to maintain a body in a state of static equilibrium.*

ACCT -OS-6 Students will explore career pathways in the construction industry.

- a. Demonstrate knowledge of the job opportunities that are available to entry level employees.*
- b. Demonstrate knowledge of the post-secondary training opportunities that are available.*
- c. Demonstrate knowledge of the industry licenses and certifications available.*

Academic Standards:

SSEF3. The student will explain how specialization and voluntary exchange between buyers and sellers increase the satisfaction of both parties.

- a. Give examples of how individuals and businesses specialize.*
- b. Explain that both parties gain as a result of voluntary, non-fraudulent exchange.*

SSEM13. The student will explain how markets, prices and competition influence economic behavior.

- c. Define price elasticity of demand and supply.*

Reading Across the Curriculum

Reading Standard Comment

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After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

Students will enhance reading in all curriculum areas by:

- a. Reading in all curriculum areas
 - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
 - Read both informational and fictional texts in a variety of genres and modes of discourse.
 - Read technical texts related to various subject areas.
- b. Discussing books
 - Discuss messages and themes from books in all subject areas.
 - Respond to a variety of texts in multiple modes of discourse.
 - Relate messages and themes from one subject area to messages and themes in another area.
 - Evaluate the merit of texts in every subject discipline.
 - Examine author's purpose in writing.
 - Recognize the features of disciplinary texts.
- c. Building vocabulary knowledge
 - Demonstrate an understanding of contextual vocabulary in various subjects.

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- Use content vocabulary in writing and speaking.
 - Explore understanding of new words found in subject area texts.
- d. Establishing context
- Explore life experiences related to subject area content.
 - Discuss in both writing and speaking how certain words are subject area related.
 - Determine strategies for finding content and contextual meaning for unknown words.

FOUNDATION SKILLS

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: *Learners achieve state academic standards at or above grade level.*

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: *Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.*

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and

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teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: *Learners plan and manage academic-career plans and employment relations.*

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY**

CAREER PATHWAY:

COURSE TITLE:

Introduction to Metals

Prerequisite:

Occupational Safety and Fundamentals

The metals technology curriculum, Introduction to Metals, is designed to acquaint participants with the three major technical occupations (welding, sheet metal, and machining) that are available in the metal forming, manufacturing, and metals/construction industries. The various activities equip high school students with the skills needed to select a metal industry occupation, enter the work force, and continue to advance in one of these specialized metals occupations. Experiences include an introduction to the basic requirements of each of these fields, exposure to the structure and nature of career opportunities, and an introduction to types of training and skills required and the use of specialized tools, equipment, and materials. This course is designed to familiarize students with fundamentals of various metal occupations for the purpose of preparing them to select either welding, sheet metal, or machining for more highly specialized training in subsequent courses. Minimum performance requirements for this course are based on successful student completion according to the National Center for Construction Education and Research Center (NCCER) Occupation Standards and the National Institute for Metalforming Skills (NIMS) standards. Students who successfully complete the course in accordance with NCCER standards are eligible for registration with the NCCER National Craft Worker Registry or obtain NIMS credentials.

CAREERS, ETHICS, AND HISTORY OF MACHINING, SHEETMETAL, AND WELDING

This course will acquaint the students with the history of the machining trade, equipment used in the trade, attributes of successful machinists, sheet metal workers, welders,

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industry credentialing, and career opportunities. Course topics include safety, applied mathematics, measuring instruments, blueprint reading, and metallurgy. Practical experience will be gained in the proper use and maintenance of hand tools, power tools and equipment used in the industry. Additional topics address quality control, environmental protection, and housekeeping. Co-curricular activities of Skills USA are incorporated in the course. Students who successfully complete the course are eligible to enroll in machining operations I, sheet metal I, or welding I courses.

HISTORY

ACCT-ITM-1. Students will explore the history of the machining, welding, and sheet-metal trade

- a. Summarize the history of the machining, welding, and sheet-metal trade.

Academic Standards:

SSUSH7 Students will explain the process of economic growth, its regional and national impact in the first half of the 19th century, and the different responses to it.

SAFETY

ACCT-ITM-2. Students will demonstrate knowledge of safety in the metals laboratory.

- a. Identify some common hazards in machining, sheet metal, and welding.
- b. Explain and identify proper personal protection used in machining, sheet metal, and welding.
- c. Demonstrate proper material handling methods.
- d. Demonstrate safety rules for operating tools in the metals lab.

Academic Standards:

SEV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.

- e. Describe the effects and potential implications of pollution and resource depletion on the environment at the local and global levels (*e.g.* air and water pollution, solid waste disposal, depletion of the stratospheric ozone, global warming, and land uses).

TOOLS OF THE TRADE

ACCT-ITM-3. Students will demonstrate proficiency in the use of hand tools and power tools specific to the trade.

- a. Demonstrate proficiency using tools related to the metals trade in a safe and appropriate manner.

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- b. Demonstrate proficiency in proper maintenance and care of tools in the metals trade.

MEASURING INSTRUMENTS

ACCT-ITM-4. Students will demonstrate the ability to use measuring instruments specific to the metals trade.

- a. Demonstrate proficiency measuring work pieces with a standard steel rule to the nearest 1/64”.
- b. Demonstrate proficiency in the proper care, cleaning, and storage of measuring instruments.
- c. Demonstrate proficiency in the use of measuring tools used in machining, sheet metal, and welding.

Academic Standards:

MM1G3. Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.

- a. Determine the sum of interior and exterior angles in a polygon.
- b. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
- c. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).

INTRO TO WELDING

ACCT-ITM-5. Students will demonstrate the ability to safely set up and use the oxyfuel cutting torch and SMAW equipment.

- a. Identify and explain the use of oxyfuel cutting equipment.
- b. Demonstrate proficiency in safely set up and shutting down an oxyfuel cutting outfit.
- c. Perform basic oxyfuel cutting
- d. Identify and explain shielded metal arc welding (SMAW) safety.
- e. Identify and explain welding electrical current.
- f. Identify and explain arc welding machines.
- g. Demonstrate proficiency in safely setting up SMAW equipment.
- h. Demonstrate proficiency striking an arc.
- i. Demonstrate proficiency running stringer beads.

Academic Standards:

SPS10. Students will investigate the properties of electricity and magnetism.

- a. Investigate static electricity in terms of
 - friction
 - induction
 - conduction

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- b. Explain the flow of electrons in terms of
 - alternating and direct current.
 - the relationship among voltage, resistance and current.

SPS4. Students will investigate the arrangement of the Periodic Table.

- a. Determine the trends of the following:
 - Location of metals, nonmetals, and metalloids

INTRO TO SHEET METAL

ACCT-ITM- 6. Students will demonstrate the ability to use basic hand tools and equipment specific to sheet metal.

- a. Demonstrate proficiency in the selection and use of layout and marking tools used by sheet metal workers.
- b. Demonstrate proficiency in the selection of hand tools used for cutting out sheet metal parts and patterns.
- c. Demonstrate proficiency in the selection and use of sheet metal equipment as applied to straight line development.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.
- b. Determine the distance between a point and a line.
- c. Determine the midpoint of a segment.
- d. Understand the distance formula as an application of the Pythagorean theorem.
- e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

MM1G3. Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.

- d. Determine the sum of interior and exterior angles in a polygon.
- e. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
- f. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
- g. Understand, use, and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
- h. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

MM2G1. Students will identify and use special right triangles.

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- a. Determine the lengths of sides of 30° - 60° - 90° triangles.
- b. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM2G3. Students will understand the properties of circles.

- a. Understand and use properties of chords, tangents, and secants as an application of triangle similarity.
- b. Understand and use properties of central, inscribed, and related angles.
- c. Use the properties of circles to solve problems involving the length of an arc and the area of a sector.
- d. Justify measurements and relationships in circles using geometric and algebraic properties.

MM2G4. Students will find and compare the measures of spheres.

- a. Use and apply surface area and volume of a sphere.
- b. Determine the effect on surface area and volume of changing the radius or diameter of a sphere.

INTRO TO MACHINING

ACCT-ITM-7. Students will demonstrate the ability to use basic hand tools and equipment specific to machining.

- a. Demonstrate proficiency in the selection and use of basic layout tools used by machinist.
- b. Demonstrate proficiency in the selection and use of machine shop equipment to produce basic layout projects.

Academic Standards:

MM2G1. Students will identify and use special right triangles.

- a. Determine the lengths of sides of 30° - 60° - 90° triangles.
- b. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM1G3. Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.

- a. Determine the sum of interior and exterior angles in a polygon.
- b. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
- c. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
- d. Understand, use, and prove properties of and relationships among special

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quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.

- e. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.
- b. Determine the distance between a point and a line.
- c. Determine the midpoint of a segment.
- d. Understand the distance formula as an application of the Pythagorean theorem.
- e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

- c. Reading in all curriculum areas

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- Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
 - Read both informational and fictional texts in a variety of genres and modes of discourse.
 - Read technical texts related to various subject areas.
- d. Discussing books
- Discuss messages and themes from books in all subject areas.
 - Respond to a variety of texts in multiple modes of discourse.
 - Relate messages and themes from one subject area to messages and themes in another area.
 - Evaluate the merit of texts in every subject discipline.
 - Examine author's purpose in writing.
 - Recognize the features of disciplinary texts.
- e. Building vocabulary knowledge
- Demonstrate an understanding of contextual vocabulary in various subjects.
 - Use content vocabulary in writing and speaking.
 - Explore understanding of new words found in subject area texts.
- f. Establishing context
- Explore life experiences related to subject area content.
 - Discuss in both writing and speaking how certain words are subject area related.
 - Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

The Foundation Skills for Career, Technical, and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

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CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health, and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

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PROGRAM CONCENTRATION:
Construction,

Architecture,

Transportation

Communications &

CAREER PATHWAY:

METALS

TECHNOLOGY

COURSE TITLE:

Machining

Operations I

Prerequisite:

Introduction to

Metals

The metals technology curriculum, Metals I This course will provide opportunities for students to acquire introductory skills on the lathe and milling machine, equipment used in the trade, attributes of successful machinists, industry credentialing, and career opportunities. Course topics include safety, measuring instruments, blueprint reading, and maintenance. Practical experience will be gained in the proper use and maintenance of hand tools, the pedestal grinder, the drill press, and band saws, job planning and management, quality control, and machinery maintenance. Performance standards for this course are based on National Institute for Metalworking Skills (NIMS) national standards for the topics of lathe and milling machine.

Additional topics address quality control, environmental protection, and housekeeping. Co-curricular activities of Skills USA are incorporated in the course. Students who successfully complete the course are eligible to enroll in Machining Operations II

SAFETY

ACCT-MOI-1. Students will demonstrate safety in the machining lab and classroom.

- a. List general safety rules for the machining laboratory
- b. Identify the location of the following: fire extinguisher(s), eye wash station, first aid kit, emergency electrical shutoff(s)
- c. Describe the types of fires possible in a machining environment and identify the appropriate fire extinguisher for each type of fire
- d. Demonstrate the use of a fire extinguisher
- e. Demonstrate basic first aid to stop bleeding and prevent shock
- f. Describe the procedure for obtaining outside emergency medical response
- g. Demonstrate emergency shutoff procedures
- h. Demonstrate shop evacuation procedures
- i. Identify location of Material Safety and Data Sheets (MSDS)

MEASURING INSTRUMENTS

Implementation date
Fall 2010

DRAFT

ACCT-MOI-2. Students will measure with the following to specific tolerances

- a. Measure work pieces with a 6 inch Standard rule
- b. Measure work pieces with a 12 inch Standard rule
- c. Measure work pieces 0-1” Micrometer
- d. Measure work pieces with dial and vernier calipers
- e. Use a dial indicator

Academic Standards:

MM2P1. Students will solve problems (using the appropriate technology.)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

BLUEPRINT READING

ACCT-MOI-3. Students will identify and illustrate the following information on blueprints.

- a. Identify title block and tell what information it contains.
- b. Identify basic blueprint symbols and lines.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.
- b. Determine the distance between a point and a line.
- c. Determine the midpoint of a segment.
- d. Understand the distance formula as an application of the Pythagorean theorem.
- e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

PEDESTAL GRINDER

ACCT-MOI-4. Students will demonstrate the ability to properly set up and use the pedestal grinder.

- a. Inspect and clean a pedestal grinder.
- b. Inspect and position eye shields and tool rests.
- c. Dress grinding wheels.
- d. Sharpen center punches and chisels
- e. Sharpen drill bits.

Implementation date
Fall 2010

DRAFT

DRILL PRESS

ACCT-MOI-5. Students will demonstrate the ability to properly set up and use the drill press.

- a. Inspect and clean drill press.
- b. Mount and secure work piece.
- c. Calculate proper RPMs on the drill press.
- d. Demonstrate center drilling.
- e. Drill pilot holes.
- f. Drill blind holes.
- g. Drill through holes.

Academic Standards:

MM4P1. Students will solve problems (using the appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

SPS7. The students will relate transformations and flow of energy within a system.

- b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation.

SPS8. Students will determine relationships among force, mass, and motion.

- a. Calculate velocity and acceleration.
- c. Calculate amounts of work and mechanical advantage using simple machines.

LATHE OPERATIONS

ACCT-MOI-6. Students will perform the following operations using the lathe.

- a. Identify the parts of an engine lathe
- b. Check oil reservoirs and cutting fluid levels
- c. Calculate feeds and speeds for various materials and material diameters
- d. Set up a lathe for various feeds and speeds.
- e. Grind general lathe cutting tools with a pedestal grinder.
- f. Demonstrate set-up and alignment of the tool post.
- g. Demonstrate set-up of the three-jaw chuck.
- h. Perform facing operations.
- i. Perform center drilling operations

Academic Standards:

MM4P1. Students will solve problems (using the appropriate technology)

- b. Build new mathematical knowledge through problem solving.

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- c. Apply and adapt a variety of appropriate strategies to solve problems.

SPS7. The students will relate transformations and flow of energy within a system.

- b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation.

SPS8. Students will determine relationships among force, mass, and motion.

- a. Calculate velocity and acceleration.
- c. Calculate amounts of work and mechanical advantage using simple machines.

MILL OPERATIONS

ACCT-MOI-7. Students will perform the following operations using the milling machine.

- a. Identify the parts of a milling machine.
- b. Check oil reservoirs and cutting fluid levels.
- c. Calculate feeds and speeds for various materials and material diameters.
- d. Set up a mill for various feeds and speeds.
- e. Use an edge finder to find the edge of a part.
- f. Perform center drilling operations.
- g. Perform countersinking operations.
- h. Perform drilling operations.
- i. Perform Taping operations.

Academic Standards:

MM2P1. Students will solve problems (using the appropriate technology.)

- d. Build new mathematical knowledge through problem solving.
- e. Solve problems that arise in mathematics and in other contexts.
- f. Apply and adapt a variety of appropriate strategies to solve problems.

SPS7. The students will relate transformations and flow of energy within a system.

- b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation.

SPS8. Students will determine relationships among force, mass, and motion.

- a. Calculate velocity and acceleration.
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MACHINERY MAINTENANCE

ACCT-MTM-8. Students will perform the following maintenance procedures

- a. Perform incidental and preventative maintenance on a milling machine, lathe, pedestal grinder, and drill press.

Implementation date
Fall 2010

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- b. Fill out the history form for tracking maintenance
- c. Report maintenance problems to the teacher

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

- e. Reading in all curriculum areas
 - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
 - Read both informational and fictional texts in a variety of genres and modes of discourse.
 - Read technical texts related to various subject areas.
- f. Discussing books
 - Discuss messages and themes from books in all subject areas.
 - Respond to a variety of texts in multiple modes of discourse.
 - Relate messages and themes from one subject area to messages and themes in another area.
 - Evaluate the merit of texts in every subject discipline.
 - Examine author's purpose in writing.
 - Recognize the features of disciplinary texts.
- g. Building vocabulary knowledge

Implementation date
Fall 2010

- Demonstrate an understanding of contextual vocabulary in various subjects.
 - Use content vocabulary in writing and speaking.
 - Explore understanding of new words found in subject area texts.
- h. Establishing context
- Explore life experiences related to subject area content.
 - Discuss in both writing and speaking how certain words are subject area related.
 - Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

The Foundation Skills for Career, Technical, and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

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Fall 2010

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health, and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY**

CAREER PATHWAY:

Machining Operations II

COURSE TITLE:

Machining Operations I

PREREQUISITE:

Implementation date
Fall 2010

DRAFT

COURSE DESCRIPTION: *This course will provide opportunities for students to acquire introductory skills on the lathe and milling machine. Course topics include safety, blueprint reading, job planning and management, quality control, and machinery maintenance. Performance standards for this course are based on National Institute for Metalworking Skills (NIMS) national standards for the topics of lathe and milling machine. Co-curricular activities of Skills USA are incorporated in the course. Students who successfully complete this course are eligible to enroll in Machining Operations III and/or Machining Operations IV.*

SAFETY

ACCT-MOII-1. Students will demonstrate safety in the machining lab and classroom.

- a. Demonstrate general safety rules for the machining laboratory.
- b. Demonstrate the specific safety rules applicable to the machine shop equipment.

BLUEPRINT READING

ACCT-MOII-2. Students will compose blueprints.

- a. Define orthographic projection.
- b. Sketch the top, front, and side views of simple machined parts.
- c. Illustrate proper dimensioning.

Academic standards:

MM2G1. Students will identify and use special right triangles.

- a. Determine the lengths of sides of 30 -60 -90 triangles.
- b. Determine the lengths of sides of 45 -45 90 triangles.

MM2P1. Students will solve problems (using the appropriate technology.)

- g. Build new mathematical knowledge through problem solving.
- h. Solve problems that arise in mathematics and in other contexts.
- i. Apply and adapt a variety of appropriate strategies to solve problems.

JOB PLANNING AND MANAGEMENT

ACCT-MOII-3. Students will generate job planning sheets for lathe and milling machine projects.

- a. Develop a process plan and sequence of operations for a part requiring turning.
- b. Develop a process plan and a sequence of operations for a part requiring milling.

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- c. Complete a materials list and identify required tools, fixtures, and cutting fluids for a machining operation.

Academic standards:

MM2P1. Students will solve problems (using the appropriate technology)

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- c. Apply and adapt a variety of appropriate strategies to solve problems.

SPS7. The students will relate transformations and flow of energy within a system.

- b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation.

SPS8. Students will determine relationships among force, mass, and motion.

- a. Calculate velocity and acceleration.
- c. Calculate amounts of work and mechanical advantage using simple machines.

BASIC LATHE

ACCT-MOII-4. Students will demonstrate the ability to properly set up and use the lathe.

- a. Perform countersinking operations.
- b. Perform drilling operations.
- c. Perform filing operations on a lathe.
- d. Demonstrate set-up of the quick change tool holder.
- e. Center drill work piece for turning between centers.
- f. Perform turning operations to specified tolerances.
- g. Perform boring operations.
- h. Perform counterboring operations.

Academic standards:

MM2P1. Students will solve problems (using the appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- d. Solve problems that arise in mathematics and in other contexts.
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- a. Calculate velocity and acceleration.
- c. Calculate amounts of work and mechanical advantage using simple machines.

BASIC MILL

Implementation date
Fall 2010

DRAFT

ACCT-MOII-5. Students will demonstrate the ability to properly set up and use the vertical milling machine.

- a. Set up and dial in a vise.
- b. Identify milling cutters used in vertical milling.
- c. Demonstrate reaming operations.
- d. Demonstrate boring operations.
- e. Demonstrate end milling operations.
- f. Demonstrate face milling operations.
- g. Square a work piece to specified tolerances.

Academic standards:

SPS7. The students will relate transformations and flow of energy within a system.

- b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation.

SPS8. Students will determine relationships among force, mass, and motion.

- a. Calculate velocity and acceleration.
- c. Calculate amounts of work and mechanical advantage using simple machines

MM2P1. Students will solve problems (using the appropriate technology).

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

QUALITY CONTROL

ACCT-MOII-6. Students will judge lathe and milling machine parts to determine the quality of the parts.

- a. Develop an inspection plan.
- b. Select required measuring instruments.
- c. Inspect a part produced on a lathe.
- d. Inspect a part produced on a milling machine.
- e. Complete a written inspection report to include a decision to accept or reject the part.
- f. Describe inspection procedures, results, and decisions.

Academic standards:

MM4P1. Students will solve problems (using the appropriate technology)

- c. Build new mathematical knowledge through problem solving.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

MACHINERY MAINTENANCE

Implementation date
Fall 2010

DRAFT

ACCT-MOII-7. Students will demonstrate the ability to perform preventive maintenance on the lathe and milling machine.

- a. Perform incidental and preventative maintenance on a lathe and a milling machine.
- b. Report problems that are beyond the scope of authority.
- c. Fill out the history form for tracking maintenance.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal learning. Students encounter a variety of informational as well as fictional texts, and they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in *context*.

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Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

Reading in All Curriculum Areas

- Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
- Read both informational and fictional texts in a variety of genres and modes of discourse.
- Read technical texts related to various subject areas.

Discussing Books

- Discuss messages and themes from books in all subject areas.
- Respond to a variety of texts in multiple modes of discourse.

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- Relate messages and themes from one subject area to messages and themes in another area.
- Evaluate the merit of texts in every subject discipline.
- Examine author's purpose in writing.
- Recognize the features of disciplinary texts.

Building Vocabulary Knowledge

- Demonstrate an understanding of contextual vocabulary in various subjects.
- Use content vocabulary in writing and speaking.
- Explore understanding of new words found in subject area texts.

Establishing Context

- Explore life experiences related to subject area content.
- Discuss in both writing and speaking how certain words are subject area related.
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CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

Implementation date
Fall 2010

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CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY
Machining Operations III
Machining Operations II**

CAREER PATHWAY:

COURSE TITLE:

PREREQUISITE:

COURSE DESCRIPTION: This course will provide opportunities for students to continue skills development on the lathe and milling machine. Course topics include safety, blueprint reading, job planning and management, quality control, and machinery maintenance. Performance standards for this course are based on National Institute for Metalworking Skills (NIMS) national standards for the topics of lathe and milling machine. Co-curricula activities of Skills USA are incorporated in the course. They may also apply for the following national credentials: NIMS Turning between Centers Level I, NIMS Turning-Chucking Level I, and NIMS Milling Level I.

SAFETY

ACCT-MOIII-1. Students will demonstrate safety in the machining lab and classroom.

- a. Apply general safety rules for the machining laboratory.

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- b. Apply the specific safety rules applicable to specific machine shop equipment.

BLUEPRINT READING

ACCT-MOIII-2. Students will devise sketches of various machined parts.

- a. Sketch sectional views of simple and complex machined parts.
- b. Sketch a half sectional view of a complex machined part.

Academic standards:

MM3G1. Students will investigate the relationships between lines and circles.

- a. Find equations of circles.
- c. Find the equation of a tangent line to a circle at a given point.
- d. Solve a system of equations involving a circle and a line.

INTERMEDIATE LATHE

ACCT-MOIII-4. Students will demonstrate the ability to properly setup and use the lathe.

- a. Perform knurling operations.
- b. Demonstrate setup of a draw-in collet chuck.
- c. Demonstrate cutting a taper using taper attachment.
- d. Demonstrate cutting a taper using compound rest.
- e. Demonstrate parting operations.
- f. Cut external UNF and UNC right hand and left hand threads to a specified class of fit.
- g. Deburr threads with a thread file.
- h. k. Complete NIMS Turning Between Centers Level I project.
- i. l. Complete NIMS Turning-Chucking Level I project.

Academic standards:

MM2P1. Students will solve problems (using the appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

MM4A2. Students will use the circle to define the trigonometric functions.

- b. Understand and apply the six trigonometric functions of general angles in standard position.
- c. Find values of trigonometric functions using points on the terminal sides of angles in the standard position.
- d. Understand and apply the six trigonometric as functions of arc length on the unit circle.

SPS7. The students will relate transformations and flow of energy within a system.

Implementation date
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- b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation.

SPS8. Students will determine relationships among force, mass, and motion.

- a. Calculate velocity and acceleration.
- c. Calculate amounts of work and mechanical advantage using simple machines.

INTERMEDIATE MILLING MACHINE

ACCT-MOIII-5. Students will demonstrate the ability to properly setup and use the vertical milling machine.

- a. Indicate head for X and Y axis alignment.
- b. Align milling machine vise using dial indicator.
- c. Align milling machine fixtures and attachments.
- d. Locate work with center finder, edge finders, and indicators.
- e. Mill a keyway.
- f. Mill a chamfer.
- g. Complete NIMS Milling Level I project.

Academic standards:

MM2P1. Students will solve problems (using the appropriate technology)

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- c. Apply and adapt a variety of appropriate strategies to solve problems.

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QUALITY CONTROL

Implementation date
Fall 2010

DRAFT

ACCT-MOIII-6. Students will judge machined parts to determine their quality.

- a. Develop an inspection plan.
- b. Select required measuring instruments.
- c. Inspect a part produced on a lathe.
- d. Inspect a part produced on a milling machine.
- e. Complete a written inspection report to include a decision to accept or reject the parts.

MACHINERY MAINTENANCE

ACCT-MOIII-7. Students will demonstrate the ability to perform maintenance on the lathe milling machine.

- a. Perform incidental and preventative maintenance on machine shop equipment.
- b. Report problems that are beyond the scope of authority.
- c. Fill out the history form for tracking maintenance.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal learning. Students encounter a variety of informational as well as fictional texts, and they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in *context*.

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CTAE-RC-1 Students will enhance reading in all curriculum areas by:

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Fall 2010

Reading in All Curriculum Areas

- Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
- Read both informational and fictional texts in a variety of genres and modes of discourse.
- Read technical texts related to various subject areas.

Discussing Books

- Discuss messages and themes from books in all subject areas.
- Respond to a variety of texts in multiple modes of discourse.
- Relate messages and themes from one subject area to messages and themes in another area.
- Evaluate the merit of texts in every subject discipline.
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Building Vocabulary Knowledge

- Demonstrate an understanding of contextual vocabulary in various subjects.
- Use content vocabulary in writing and speaking.
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Establishing Context

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CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

Implementation date
Fall 2010

DRAFT

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation**

CAREER PATHWAY:

METALS TECHNOLOGY

COURSE TITLE:

Machining Operations IV

PREREQUISITE:

Machining Operations III

COURSE DESCRIPTION: This course will provide opportunities for students to pursue more advanced skills on the lathe and milling machine. Course topics include safety, blueprint reading, job planning and management, quality control, and career planning. Performance standards for this course are based on National Institute for Metalworking Skills (NIMS) national standards for the topics of lathe, and milling machine. Co-curricular activities of SkillsUSA are incorporated in the course.

SAFETY

ACCT-MOIV-1. Students will demonstrate the ability to identify the different aspects of machine safety.

- a. List general safety rules for the machining laboratory.
- b. Explain and demonstrate how to clean a machine after each use.

BLUEPRINT READING

ACCT-MOIV-2. Students will demonstrate proficiency in blueprint reading.

- a. Identify material to be used.
- b. Identify unspecified tolerances.
- c. Determine what each note is referring to.
- d. Determine what finishing operations must be done to the part.
- e. Identify relationship to other parts in the assembly.
- f. Identify each line on the print.
- g. Identify specified tolerances.
- h. Identify and interpret specific notes.
- i. Identify order of operations for machining the part.

Academic standards:

MM2P1. Students will solve problems (using the appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

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JOB PLANNING AND MANAGEMENT

ACCT-MOIV-3. Students will generate job planning sheets for turning and milling projects.

- a. Develop a process plan and sequence of operations for a part requiring turning.
- b. Develop a process plan and a sequence of operations for a part requiring milling.
- c. Complete a materials list and identify required tools, fixtures, and cutting fluids for a machining operation.

ADVANCED LATHE

ACCT-MOIV-4. Students will demonstrate the ability to perform advanced operations on the lathe.

(The following objectives should follow successful completion of the NIMS Turning Between Centers Level I examination and/or the NIMS Turning-Chucking Level I examination.)

- a. Demonstrate centering work in a four jaw chuck using a dial indicator.
- b. Demonstrate offset turning with a four jaw chuck.
- c. Demonstrate steady rest turning and boring.
- d. Demonstrate follower rest turning.
- e. Cut external acme threads.
- f. Rechase internal threads.
- g. Rechase external threads.
- h. Cut internal tapered surfaces.
- i. Cut 60 degree internal threads to a specified class of fit.

Academic standards:

MM2P1. Students will solve problems (using the appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

MM4A2. Students will use the circle to define the trigonometric functions.

- a. Understand and apply the six trigonometric functions of general angles in standard position.
- b. Find values of trigonometric functions using points on the terminal sides of angles in the standard position.
- c. Understand and apply the six trigonometric as functions of arc length on the unit circle.

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SPS7. The students will relate transformations and flow of energy within a system.

- b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation.

SPS8. Students will determine relationships among force, mass, and motion.

- a. Calculate velocity and acceleration.
- c. Calculate amounts of work and mechanical advantage using simple machines.

ADVANCED MILLING MACHINE

ACCT-MOIV-5. Students will demonstrate the ability to perform advanced operations on the milling machine.

(The following objectives should follow successful completion of the NIMS Milling Level I examination.)

- a. Demonstrate index milling.
- b. Demonstrate chamfering by angled cutter or tilting the head.
- c. Check cutting fluid level.
- d. Calculate feeds and speeds for various materials.
- e. Align milling machine fixtures and attachments. f. Demonstrate proper use of a T-slot cutter.
- f. Demonstrate proper use of a Woodruff keyseat cutter

Academic standards:

MM2P1. Students will solve problems (using the appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

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SPS8. Students will determine relationships among force, mass, and motion.

- a. Calculate velocity and acceleration.

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- c. Calculate amounts of work and mechanical advantage using simple machines.

CAREER PLANNING

ACCT-MOIV-6. Students will demonstrate the ability to proficiently plan for a career in the machining field.

- a. Prepare a list of companies that hire machinists.
- b. Write a resume.
- c. Conduct mock job interviews.
- d. Prepare a tentative career path for the next ten years.

Academic Standards:

SSEF6. The student will explain how productivity, economic growth, and future standards of living are influenced by investment in factories, machinery, new technology, and the health, education, and training of people.

- a. Define productivity as the relationship of inputs to outputs.
- b. Give illustrations of investment in equipment and technology and explain their relationship to economic growth.
- c. Give examples of how investment in education can lead to a higher standard of living.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal learning. Students encounter a variety of informational as well as fictional texts, and they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in *context*.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

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Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

Reading in All Curriculum Areas

- Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
- Read both informational and fictional texts in a variety of genres and modes of discourse.
- Read technical texts related to various subject areas.

Discussing Books

- Discuss messages and themes from books in all subject areas.
- Respond to a variety of texts in multiple modes of discourse.
- Relate messages and themes from one subject area to messages and themes in another area.
- Evaluate the merit of texts in every subject discipline.
- Examine author's purpose in writing.
- Recognize the features of disciplinary texts.

Building Vocabulary Knowledge

- Demonstrate an understanding of contextual vocabulary in various subjects.
- Use content vocabulary in writing and speaking.
- Explore understanding of new words found in subject area texts.

Establishing Context

- Explore life experiences related to subject area content.
- Discuss in both writing and speaking how certain words are subject area related.
- Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an

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analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

CAREER PATHWAY:

COURSE TITLE:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY
Machining Operations V**

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PREREQUISITE:

Machining Operations IV

COURSE DESCRIPTION: The goal of this course is to provide all students with an understanding of CNC (computer numerical control) Lathe. Course topics include safety, lathe operations, milling operations, and machine maintenance. The performance standards for this course are based on the National Institute for Metalworking Skills (NIMS) for the topics of the lathe and milling machine. Co-curricula activities of Skills USA are incorporated in the course.

CAREERS

This course will provide instruction for the safe operation and manual programming of computer numerical controlled (CNC) Turning machines. Competencies include: Machine Safety, Command Codes, Program loading, and Machine Setup.

SAFETY

ACCT-MOV-1. Students will identify the different aspects of machine safety.

- a. Compile a list of general safety rules that apply to chip removal from machines.
- b. Explain the safety measures and problems which apply specifically to automated movements of cutting tools on a lathe.

COMMAND CODES:

ACCT-MOV-2. Students will identify CNC programming command codes used in writing a CNC lathe program.

- a. Define the various codes and functions used in CNC programming for a lathe.
- b. Discuss the related machine tool movements resulting from the codes entered into the controller.
- c. Explain the use of “G” and “M” words.
- d. Explain the two main axis of a CNC lathe.
- e. Interpret blueprints for the correct machining operations.
- f. Write programs using all the computer words needed to set machine feeds, speeds, linear and circular interpolation, threading, and grooving.
- g. Test the programs and correct any errors.

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Academic standards:

MM2P1. Students will solve problems (using the appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

MM4A2. Students will use the circle to define the trigonometric functions.

- a. Understand and apply the six trigonometric functions of general angles in standard position.
- b. Find values of trigonometric functions using points on the terminal sides of angles in the standard position.
- c. Understand and apply the six trigonometric as functions of arc length on the unit circle.

SPS7. The students will relate transformations and flow of energy within a system.

- b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation.

SPS8. Students will determine relationships among force, mass, and motion.

- a. Calculate velocity and acceleration.
- c. Calculate amounts of work and mechanical advantage using simple machines.

PROGRAM LOADING:

ACCT-MOV-3 Students will demonstrate the ability to load programs into the controller.

- a. Describe the methods available to load programs into a controller.
- b. Manually load a program into the controller explaining each function and what the machine reaction should be.
- c. Demonstrate the setting of the origin point.
- d. Compute the feeds and speeds to establish values for the “F” and “S” words.
- e. Complete math calculations necessary to write a toolpath.

Academic standards:

MM2P1. Students will solve problems (using the appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

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- b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation.

SPS8. Students will determine relationships among force, mass, and motion.

- a. Calculate velocity and acceleration.
- c. Calculate amounts of work and mechanical advantage using simple machines.

MACHINE SETUP:

ACCT-MOV-4 Students will demonstrate the ability to set up a CNC lathe for a machining process.

- a. Select a program and determine the tooling required, the work holding device, cutting tool/tools, and work supporting accessories required to complete the operation.
- b. Determine the type of material and prepare it for mounting in the work holding device.
- c. Explain how the work will be set up in the lathe.
- d. Explain how to run the program one line at a time to test the process for accuracy and safety.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal learning. Students encounter a variety of informational as well as fictional texts, and they experience text in all genres and modes of discourse. In the study of various disciplines of learning

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(language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in *context*.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

Reading in All Curriculum Areas

- Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
- Read both informational and fictional texts in a variety of genres and modes of discourse.
- Read technical texts related to various subject areas.

Discussing Books

- Discuss messages and themes from books in all subject areas.
- Respond to a variety of texts in multiple modes of discourse.
- Relate messages and themes from one subject area to messages and themes in another area.
- Evaluate the merit of texts in every subject discipline.
- Examine author's purpose in writing.
- Recognize the features of disciplinary texts.

Building Vocabulary Knowledge

- Demonstrate an understanding of contextual vocabulary in various subjects.
- Use content vocabulary in writing and speaking.
- Explore understanding of new words found in subject area texts.

Establishing Context

- Explore life experiences related to subject area content.
- Discuss in both writing and speaking how certain words are subject area related.
- Determine strategies for finding content and contextual meaning for unknown words.

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CTAE Foundation Skills

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CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

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CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY
Machining Operations VI**

**CAREER PATHWAY:
COURSE TITLE:**

PREREQUISITE:

Machining Operations V

COURSE DESCRIPTION:

The goal of this course is to provide all students with an understanding of CNC (computer numerical control) Milling. Course topics include safety, lathe operations, milling operations, and machine maintenance. The performance standards for this course are based on the National Institute for Metalworking Skills (NIMS) for the topics of the lathe and milling machine. Co-curricula activities of Skills USA are incorporated in the course.

CAREERS

This course will provide instruction for the safe operation and manual programming of computer numerical controlled (CNC) Milling machines. Competencies include: Machine Safety, Command Codes, Program loading, and Machine Setup.

SAFETY

ACCT-MOVI-1. Students will identify the different aspects of machine safety.

- a. Compile a list of general safety rules that apply to chip removal from machines.
- b. Explain the safety measures and problems which apply specifically to automated movements of machine tables with varying heights of work pieces and fixture parts.

COMMAND CODES

ACCT-MOVI-2. Students will identify CNC programming command codes used in writing a CNC lathe program.

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- a. Define the various codes and functions used in CNC programming for a milling machine.
- b. Discuss the related machine tool movements resulting from the codes entered into the controller.
- c. Explain the use of “G” and “M” words.
- d. Explain the three main axis of a CNC milling machine.
- e. Interpret blueprints for the correct machining operations.
- f. Write programs using all the computer words needed to set machine feeds, speeds, linear and circular interpolation.
- g. Test the programs and correct any errors.

Academic standards:

MM2P1. Students will solve problems (using the appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

MM4A2. Students will use the circle to define the trigonometric functions.

- a. Understand and apply the six trigonometric functions of general angles in standard position.
- b. Find values of trigonometric functions using points on the terminal sides of angles in the standard position.
- c. Understand and apply the six trigonometric as functions of arc length on the unit circle.

SPS7. The students will relate transformations and flow of energy within a system.

- b. Investigate molecular motion as it relates to thermal energy changes in terms of conduction, convection, and radiation.

SPS8. Students will determine relationships among force, mass, and motion.

- a. Calculate velocity and acceleration.
- c. Calculate amounts of work and mechanical advantage using simple machines.

PROGRAM LOADING

ACCT-MOVI-3. Students will demonstrate the ability to identify and load programs into the controller.

- a. Describe the methods available to load programs into a controller.
- b. Manually load a program into the controller explaining each function and what the machine reaction should be.
- c. Identify the major functions of a postprocessor.

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- d. Demonstrate the setting of the origin point.
- e. Compute the feeds and speeds to establish values for the “F” and “S” words.
- f. Complete math calculations necessary to write a toolpath.

Academic standards:

MM2P1. Students will solve problems (using the appropriate technology)

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- a. Calculate velocity and acceleration.
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MACHINE SETUP

ACCT-MOVI-4. Students will demonstrate the ability to set up a machine for a machining process.

- a. Select a program and determine the tooling required, the work holding device, cutting tool/tools, and work supporting accessories required to complete the operation.
- b. Determine the type of material and prepare it for mounting in the work holding device.
- c. Explain how the work will be set up in the milling machine.
- d. Use a dial indicator to align work piece or work holding device.
- e. Explain how to run the program one line at a time to test the process for accuracy and safety.

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- f. Use machineable wax for a test work piece to reduce possible damage during the first run.
- g. Analyze the part so clamps and parts of fixtures will not be placed in the path of the cutting tool in the spindle.

Reading Across the Curriculum

Reading Standard Comment

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-Discuss messages and themes from books in all subject areas.

-Respond to a variety of texts in multiple modes of discourse.

-Relate messages and themes from one subject area to messages and themes in another area.

-Evaluate the merit of texts in every subject discipline.

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- Examine author's purpose in writing.
- Recognize the features of disciplinary texts.

Building Vocabulary Knowledge

- Demonstrate an understanding of contextual vocabulary in various subjects.
- Use content vocabulary in writing and speaking.
- Explore understanding of new words found in subject area texts.

Establishing Context

- Explore life experiences related to subject area content.
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CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

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CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY
Welding I**

**CAREER PATHWAY:
COURSE TITLE:**

PREREQUISITE:

Introduction of Metals

COURSE DESCRIPTION: This course is designed to provide all students with the basic knowledge and safe operating skills needed to demonstrate proper set of equipment in oxyfuel and shielded metal arc welding (SMAW). In oxy-fuel area of study students will create accurate cuts and perform washing and gouging procedures. Students will learn to critique their work pieces by welding codes, identifying imperfections, common test methods, and evaluate setups to determine proper setup of work and equipment. In SMAW students will learn and model proper safety and learn to make judgment calls in selection of electrodes and metal preparation to create beads and fillet welds using various rods. Minimum performance requirements for this course are based on successful student completion according to the American Welding Society (AWS) and the National Center for Construction Education and Research Center (NCCER) Occupation Standards. Students who successfully complete the course in accordance with NCCER standards are eligible for registration with the NCCER National Craft Worker Registry.

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CAREERS, WORK ETHICS AND HISTORY OF SMAW AND OXYFUEL WELDING PROCEDURES.

Students will explore different types of careers that are available in the welding industry and list careers they judge as meaningful. Evaluate their own skill level and determine skills needed to reach career choices through research. Students will learn the importance of good work ethics in the workplace and model that behavior. Students will learn the history of SMAW and Oxyfuel welding comparing techniques of the past to modern day techniques and equipment.

OXYFUEL CUTTING/WELDING

ACCT-WI-1. Students will be able to identify and use oxy-fuel cutting/welding equipment.

- a. Identify and explain the use of oxyfuel cutting equipment.
- b. Set up oxyfuel equipment.
- c. Light and adjust an oxyfuel torch.
- d. Disassemble oxyfuel equipment.
- e. Perform advanced oxyfuel cutting techniques:
 - Straight line and square shapes
 - Piercing and slot cutting
 - Bevels
 - Washing
 - Gouging
- f. Operate a motorized, portable oxyfuel cutting machine.

Academic Standards:

MM4P3. Students will solve problems (using appropriate technology)

- a. Build new mathematical knowledge through problem solving.

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- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.
- d. Monitor and reflect on the process of mathematical problem solving.

MM3P5. Students will communicate mathematically.

- a. Organize and consolidate their mathematical thinking through communication.
- b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
- c. Analyze and evaluate the mathematical thinking and strategies of others.
- d. Use the language of mathematics to express mathematical ideas precisely.

WELDING PROCEDURES

ACCT-WI-2. Students will demonstrate understanding of the importance of welding procedures and how to critique their work.

- a. Identify and explain codes governing welding.
- b. Identify and explain weld imperfections and their causes.
- c. Identify and explain nondestructive examination processes.
- d. Identify common destructive testing methods.
- e. Identify and explain welder qualification tests.
- f. Explain the importance of quality workmanship.

Academic Standards:

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.

SMAW

ACCT-WI-3. Students will learn and model proper safety for SMAW and make meaning of the welding codes, metallurgy, metal preparation, demonstrating their ability to evaluate factors to determine electrode required.

- a. Identify and explain shielded metal arc welding (SMAW) safety.
- b. Identify and explain welding electrical equipment.

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- c. Identify and explain arc welding machines.
- d. Explain setting up arc welding equipment.
- e. Set up a machine for welding.
- f. Identify and explain tools for weld cleaning.
- g. Identify factors that affect electrode selection.
- h. Explain the American Welding Society (AWS) and the American Society of Mechanical Engineers (ASME) filler metal classification system.
- i. Identify different types of filler metals.
- j. Explain filler metal traceability requirements and how to use applicable code requirements.
- k. Identify and select the proper electrode for an intended welding task.

Academic Standards:

SPS4. Students will investigate the arrangement of the Periodic Table

- a. Determine the trends of the following:
Location of metals, nonmetals, and metalloids
- b. Use the Periodic Table to predict the above properties for representative elements.

SMAW

ACCT-WI-4. Students will make stringer beads and/or padding using the Shielded Metal Arc Welding (SMAW) process to the instructor's discretion and satisfaction in the flat position using E-6013, E-6010 or E-7018 electrodes.

- a. Demonstrate a working knowledge of the equipment and the safe operation of the equipment.
- b. Demonstrate knowledge of the equipment needed to perform this task.
- c. Demonstrate proper weld procedures by producing welds in the flat position using E-6013, E-6010 or E-7018 electrodes.

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MM4P3. Students will solve problems (using appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.
- d. Monitor and reflect on the process of mathematical problem solving.

MM3P5. Students will communicate mathematically.

- a. Organize and consolidate their mathematical thinking through communication.
- b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
- c. Analyze and evaluate the mathematical thinking and strategies of others.
- d. Use the language of mathematics to express mathematical ideas precisely.

SMAW

ACCT-WI-5. Students will make fillet welds using the Shielded Metal Arc Welding (SMAW) process to the instructor's discretion and satisfaction in the flat (1F) and/or horizontal (2F) positions using E-6013, E-6010 or E-7018 electrodes.

- a. Demonstrate a working knowledge of the equipment and the safe operation of the equipment.
- b. Demonstrate knowledge of the equipment needed to perform this task.
- c. Demonstrate proper weld procedures by producing single and multiple pass fillet welds in the flat or horizontal position on a variety of joints using E-6013, E-6010 and/or E-7018 electrodes.

Academic Standards:

MM4P3. Students will solve problems (using appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.
- d. Monitor and reflect on the process of mathematical problem solving.

MM3P5. Students will communicate mathematically.

- a. Organize and consolidate their mathematical thinking through communication.
- b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
- c. Analyze and evaluate the mathematical thinking and strategies of others.
- d. Use the language of mathematics to express mathematical ideas precisely.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

- g. Reading in all curriculum areas
 - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
 - Read both informational and fictional texts in a variety of genres and modes of discourse.
 - Read technical texts related to various subject areas.
- h. Discussing books
 - Discuss messages and themes from books in all subject areas.
 - Respond to a variety of texts in multiple modes of discourse.
 - Relate messages and themes from one subject area to messages and themes in another area.
 - Evaluate the merit of texts in every subject discipline.
 - Examine author's purpose in writing.

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- Recognize the features of disciplinary texts.
- i. Building vocabulary knowledge
 - Demonstrate an understanding of contextual vocabulary in various subjects.
 - Use content vocabulary in writing and speaking.
 - Explore understanding of new words found in subject area texts.
- j. Establishing context
 - Explore life experiences related to subject area content.
 - Discuss in both writing and speaking how certain words are subject area related.
 - Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state’s academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education’s 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and

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improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY**

CAREER PATHWAY:

COURSE TITLE:

Welding II

PREREQUISITE:

Welding I

COURSE DESCRIPTION: This course is designed to provide all students with the basic knowledge and safe operating skills required to perform industry entry-level skills in the use of shielded metal arc welding equipment (SMAW) and an introduction to gas metal arc welding (GMAW) setup and operations. In SMAW welding students will produce welds using 6010 and 7018 electrodes in the flat (1F), horizontal (2F), and vertical (3F) fillet welds using the procedure in the flat, vertical, and horizontal positions using E-6010 and E-7018 electrodes. In GMAW welding students will produce fillet

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welds in the flat (1F) position. Minimum performance requirements for this course are based on successful student completion according to the American Welding Society (AWS) and the National Center for Construction Education and Research Center (NCCER) Occupation Standards. Students who successfully complete the course in accordance with NCCER standards are eligible for registration with the NCCER National Craft Worker Registry.

CAREERS, WORK ETHICS AND HISTORY OF SMAW AND GMAW WELDING PROCEDURES.

Students will explore different types of careers that are available in the welding industry and list careers they judge as meaningful. Evaluate their own skill level and determine skills needed to reach career choices through research. Students will learn the importance of good work ethics in the workplace and model that behavior. Students will learn the history of SMAW and GMAW welding, comparing techniques of the past to modern day techniques and equipment.

SMAW

ACCT-WII-1. Students will make fillet welds using the Shielded Metal Arc Welding (SMAW) process to the instructor's discretion and satisfaction in the horizontal (2F) positions using E-6010 and/or E-7018 electrodes.

- d. Demonstrate a working knowledge of the equipment and the safe operation of the equipment.
- e. Demonstrate knowledge of the equipment needed to perform this task.
- f. Demonstrate knowledge of the equipment by evaluating equipment setup and making judgments as to settings to create fillet welds in the horizontal (2F) position on a variety of joints using E-6010 and/or E-7018 electrodes.

Academic Standards:

MM4P1. Students will solve problems (using appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.
- d. Monitor and reflect on the process of mathematical problem solving.

SCSh3. Students will identify and investigate problems scientifically.

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- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- d. Collect, organize and record appropriate data.

SMAW

ACCT-WII-2. Students will make fillet welds using the Shielded Metal Arc Welding (SMAW) process to the instructor's discretion and satisfaction in the Vertical (3F) positions using E-6010 and/or E-7018 electrodes.

- a. Demonstrate a working knowledge of the equipment and the safe operation of the equipment.
- b. Demonstrate knowledge of the equipment needed to perform this task.
- c. Demonstrate knowledge of the equipment by evaluating equipment setup and making judgments as to settings to create single and multiple pass fillet welds in the vertical position on a variety of joints using E-6010 and/or E-7018 electrodes.

Academic Standards:

MM4P1. Students will solve problems (using appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.
- d. Monitor and reflect on the process of mathematical problem solving.

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.

GMAW

ACCT-WII-3. Students will demonstrate understanding of the Gas Metal Arc Welding (GMAW) process.

- a. Identify the parts of a GMAW welding machine.
- b. Demonstrate knowledge of the equipment and its safe operation.
- c. Demonstrate a knowledge of the different types of gases to be used in the GMAW welding process including 75/25, CO₂, 95/5 and Tri-Mix and make judgments as to what gas is used in different applications.
- d. Run beads and create fillet welds using the GMAW process in the flat position.

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Academic Standards:

MM4P1. Students will solve problems (using appropriate technology)

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.
- d. Monitor and reflect on the process of mathematical problem solving.

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate techniques in all laboratory situations.
- c. Follow correct protocol for identifying and reporting safety problems and violations.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

- i. Reading in all curriculum areas
 - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.

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- Read both informational and fictional texts in a variety of genres and modes of discourse.
 - Read technical texts related to various subject areas.
- j. Discussing books
- Discuss messages and themes from books in all subject areas.
 - Respond to a variety of texts in multiple modes of discourse.
 - Relate messages and themes from one subject area to messages and themes in another area.
 - Evaluate the merit of texts in every subject discipline.
 - Examine author’s purpose in writing.
 - Recognize the features of disciplinary texts.
- k. Building vocabulary knowledge
- Demonstrate an understanding of contextual vocabulary in various subjects.
 - Use content vocabulary in writing and speaking.
 - Explore understanding of new words found in subject area texts.
- l. Establishing context
- Explore life experiences related to subject area content.
 - Discuss in both writing and speaking how certain words are subject area related.
 - Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state’s academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education’s 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

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CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY**

CAREER PATHWAY:

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COURSE TITLE:
III

Welding

PREREQUISITE:
II

Welding

COURSE DESCRIPTION: This course is designed to provide all students with the basic knowledge and safe operating skills required to perform more advance industry entry-level skills in the use of Gas Metal Arc Welding (GMAW), introduction to Flux Cored Arc Welding (FCAW) process, and arc cutting and gouging processes using Plasma Arc and Air Carbon Arc equipment. In GMAW processes students will create fillet welds in the flat (1F), horizontal (2F), and vertical (3F) positions. In FCAW students will learn and demonstrate equipment setup and create fillet welds in the flat (1F) position. Course will also provide the student access to other cutting processes which include Plasma Arc, Air Carbon Arc Cutting and Gouging procedures. Minimum performance requirements for this course are based on successful student completion according to the American Welding Society (AWS) and the National Center for Construction Education and Research Center (NCCER) Occupation Standards. Students who successfully complete the course in accordance with NCCER standards are eligible for registration with the NCCER National Craft Worker Registry.

CAREERS, ETHICS, AND HISTORY OF GMAW, FCAW, CARBON ARC CUTTING

Students will explore different types of careers that are available in the welding industry and list careers they judge as meaningful. Evaluate their own skill level and determine skills needed to reach career choices through research. Students will learn the importance of good work ethics in the workplace and model that behavior. Students will learn the history of GMAW, FMAW, and Carbon arc cutting, comparing techniques of the past to modern day techniques and equipment.

GMAW

ACCT-WIII-1. Students will produce fillet welds using the GMAW welding process to the instructor's discretion and satisfaction in the flat (1F) or horizontal (2F) position using any of the gases discussed in the previous course.

- a. Demonstrate a working knowledge of the GMAW equipment and safe operation skills in use of GMAW equipment.
- b. Demonstrate knowledge of the equipment by evaluating equipment setup and making judgments as to settings to create fillet welds in the flat position.

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- c. Demonstrate proper weld procedures by producing single and multiple pass fillet welds in the flat and/or horizontal position on a variety of joints using the GMAW welding process.

Academic Standards:

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems

SEV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.

- a. Explain how human activities affect global and local sustainability.
- b. Describe the effects and potential implications of pollution and resource depletion on the environment at the local and global levels (e.g. air and water pollution, solid waste disposal, depletion of the stratospheric ozone, global warming, and land uses).

GMAW

ACCT-WIII-2. Students will produce fillet welds using the GMAW welding process to the instructor's discretion and satisfaction in the Vertical (3F) position using any of the gases discussed in the previous course.

- a. Demonstrate proper weld procedures by producing single and multiple pass fillet weld in the vertical position on a Tee-joint using the GMAW welding process.
- b. Demonstrate knowledge of the equipment needed to perform this task.
- c. Demonstrate a working knowledge of the GMAW equipment and the safe operation of the GMAW equipment.

Academic Standards:

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.

SEV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.

- a. Explain how human activities affect global and local sustainability.
- b. Describe the effects and potential implications of pollution and resource depletion on the environment at the local and global levels (e.g. air and water pollution, solid waste disposal, depletion of the stratospheric ozone, global warming, and land uses).

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ACCT-WIII-3. Students will demonstrate an understanding of the Plasma Arc Cutting process and identify the parts of the Plasma Arc Cutting Machine.

- a. Identify the different parts of the Plasma Arc Cutting Machine by taking apart the gun assembly and putting it back together again while explaining the Plasma Arc Cutting process to the instructor as this task is being done.
- b. Demonstrate a working knowledge of the Plasma Arc Cutting machine by making different cuts with the machine according to each instructor's discretion and instruction.
- c. Demonstrate how to make different cuts with the machine according to each instructor's discretion and instruction.

Academic Standards:

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.

ACCT-WIII-4. Students will demonstrate knowledge of the Air Carbon Arc Cutting and Gouging process by identifying the parts of the Air Carbon Arc Cutter and Gouger and using the machine.

- a. Demonstrate their knowledge of the Air Carbon Arc Cutter by making straight line cuts and circle cuts on $\frac{1}{4}$ " plate.
- b. Demonstrate their knowledge of the Air Carbon Arc Gouger by gouging out welds previously made on projects in prior courses.

Academic Standards:

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own

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specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

- k. Reading in all curriculum areas
 - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
 - Read both informational and fictional texts in a variety of genres and modes of discourse.
 - Read technical texts related to various subject areas.
- l. Discussing books
 - Discuss messages and themes from books in all subject areas.
 - Respond to a variety of texts in multiple modes of discourse.
 - Relate messages and themes from one subject area to messages and themes in another area.
 - Evaluate the merit of texts in every subject discipline.
 - Examine author's purpose in writing.
 - Recognize the features of disciplinary texts.
- m. Building vocabulary knowledge
 - Demonstrate an understanding of contextual vocabulary in various subjects.
 - Use content vocabulary in writing and speaking.
 - Explore understanding of new words found in subject area texts.
- n. Establishing context
 - Explore life experiences related to subject area content.
 - Discuss in both writing and speaking how certain words are subject area related.
 - Determine strategies for finding content and contextual meaning for unknown words.

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CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

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CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation**

CAREER PATHWAY:

METALS TECHNOLOGY

COURSE TITLE:

Welding IV

PREREQUISITE:

Welding

III

COURSE DESCRIPTION: The goal of this course is to provide all students with the basic knowledge and safe operating skills in the use of Flux Core Arc Welding equipment to produce fillet welds. This course will also provide all students with the basic knowledge and safe operating skills in the Introduction to Gas Tungsten Arc Welding equipment. This course should enable students to gain the knowledge and hands on skills to build upon skills previous obtained through earlier course studies in the welding pathway, leading toward students' career plans after leaving high school. Minimum performance requirements for this course are based on successful student completion according to the American Welding Society (AWS) and the National Center for Construction Education and Research Center (NCCER) Occupation Standards. Students who successfully complete the course in accordance with NCCER standards are eligible for registration with the NCCER National Craft Worker Registry.

CAREERS, ETHICS, AND HISTORY OF FLUX CORE ARC WELDING AND GAS TUNGSTEN ARC WELDING

Students will explore careers in the field of flux core arc welding and gas tungsten arc welding, the different applications and sciences involved in working with materials of different structure and molecular composition, and work ethics required in those career areas.

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FCAW Safety and Setup

ACCT-WIV-1. Students will understand and setup the FCAW equipment in a safe and correct manner.

- a. Identify the different parts of the FCAW and set up the machine so that it is in working order.
- b. Demonstrate knowledge of the FCAW equipment.
- c. Demonstrate safe operational skill of the FCAW equipment.

Academic Standards:

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate techniques in all laboratory situations.
- c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.

FCAW

ACCT-WIV-2. Students will produce flat (F1) and horizontal (F2) fillet welds using the FCAW welding process.

- a. Demonstrate the ability to make fillet welds in the flat (1F) and horizontal (2F) position on material provided by the instructor.
- b. Compare and evaluate both single and multiple pass welds in this position.
- c. Identify weld defects and the causes of these defects during the FCAW welding process.

Academic Standards:

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.

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FCAW

ACCT-WIV-3. Students will produce vertical (F3) fillet welds using FCAW process.

- a. Demonstrate the ability to make fillet welds in the vertical (F3) position on material provided by the instructor.
- b. Compare and evaluate both single and multiple pass welds in this position
- c. Identify weld defects and the causes of these defects during the FCAW welding process.

Academic Standards:

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate technique in all laboratory situations.
- c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Develop reasonable conclusions based on data collected.
- d. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

MM1P1. Students will solve problems (using appropriate technology).

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

GTAW

ACCT-WIV-4. Students will demonstrate understanding of Gas Tungsten Arc Welding.

- Identify equipment setup for carbon steel
- Student will demonstrate GTAW welding of stringer beads in the flat position.

Academic Standards:

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate technique in all laboratory situations.

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- c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Develop reasonable conclusions based on data collected.
- d. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SPS4. Students will investigate the arrangement of the Periodic Table.

- a. Determine the trends of the following:
 - Number of valence electrons
 - Types of ions formed by representative elements
 - Location of metals, nonmetals, and metalloids
 - Phases at room temperature
- b. Use the Periodic Table to predict the above properties for representative elements.

MM1P1. Students will solve problems (using appropriate technology).

- a. Build new mathematical knowledge through problem solving.
- b. Solve problems that arise in mathematics and in other contexts.
- c. Apply and adapt a variety of appropriate strategies to solve problems.

MM1P3. Students will communicate mathematically.

- a. Organize and consolidate their mathematical thinking through communication.
- b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.

MM2P4. Students will make connections among mathematical ideas and to other disciplines.

- a. Recognize and use connections among mathematical ideas.
- b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole.
- c. Recognize and apply mathematics in contexts outside of mathematics.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

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Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

- m. Reading in all curriculum areas
 - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
 - Read both informational and fictional texts in a variety of genres and modes of discourse.
 - Read technical texts related to various subject areas.
- n. Discussing books
 - Discuss messages and themes from books in all subject areas.
 - Respond to a variety of texts in multiple modes of discourse.
 - Relate messages and themes from one subject area to messages and themes in another area.
 - Evaluate the merit of texts in every subject discipline.
 - Examine author's purpose in writing.
 - Recognize the features of disciplinary texts.
- o. Building vocabulary knowledge
 - Demonstrate an understanding of contextual vocabulary in various subjects.
 - Use content vocabulary in writing and speaking.
 - Explore understanding of new words found in subject area texts.
- p. Establishing context
 - Explore life experiences related to subject area content.
 - Discuss in both writing and speaking how certain words are subject area related.
 - Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

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The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and

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teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY
Welding V**

CAREER PATHWAY:

COURSE TITLE:

PREREQUISITE:

Welding IV

COURSE DESCRIPTION: The goal of this course is to provide all students with the basic knowledge and safe operating skills in the use of Gas Tungsten Arc Welding equipment to produce fillet welds on carbon and /or stainless steels. This course will also provide the student with the basic knowledge and safe operating skills needed to introduce the student to Gas Tungsten Arc Welding of aluminum. This course will build upon the skills acquired in welding IV and develop the student's knowledge and experience of G.T.A.W. Minimum performance requirements for this course are based on successful student completion according to the American Welding Society (AWS) and the National Center for Construction Education and Research Center (NCCER) Occupation Standards. Students who successfully complete the course in accordance with NCCER standards are eligible for registration with the NCCER National Craft Worker Registry.

GTAW

ACCT-WV-1. Students understand and setup equipment in a safe and correct manner.

- a. Identify the parts of a G.T.A.W machine
- b. Demonstrate knowledge of equipment operation.
- c. Demonstrate safe operation of equipment.

Academic Standards:

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SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate technique in all laboratory situations.
- c. Follow correct protocol for identifying and reporting safety problems and violations.

GTAW

ACCT-WV-2. Students will produce fillet welds in the flat (1F) position

- a. Demonstrate producing fillet welds on carbon and/or stainless steel
- b. Identify possible weld defects and the causes in this position.

Academic Standards:

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Develop reasonable conclusions based on data collected.
- d. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

GTAW

ACCT-WV-3. Students will produce fillet welds in the horizontal (2F) position

- a. Demonstrate producing fillet welds on carbon and/or stainless steel
- b. Compare single and multiple pass welds in this position.
- c. Identify possible weld defects and the causes in this position.

Academic Standards:

SC5. Students will understand that the rate at which a chemical reaction occurs can be affected by changing concentration, temperature, or pressure and the addition of a catalyst.

- a. Demonstrate the effects of changing concentration, temperature, and pressure on chemical reactions.
- b. Investigate the effects of a catalyst on chemical reactions and apply it to everyday examples.

GTAW

ACCT-WV-4. Students will produce fillet welds in the vertical (3F) position

- a. Demonstrate producing fillet welds on carbon and/or stainless steel
- b. Compare single and multiple pass welds in this position.

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- c. Identify possible weld defects and the causes in this position.

Academic Standards:

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Develop reasonable conclusions based on data collected.
- d. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

GTAW

ACCT-WV-5. Student will demonstrate the understanding and set up G.T.A.W. equipment for aluminum welding.

- a. Demonstrate the ability to setup and operate machine in a safe manner.
- b. Demonstrate producing flat beads on aluminum.

Academic Standards:

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate technique in all laboratory situations.
- c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Develop reasonable conclusions based on data collected.
- d. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for

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students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

- o. Reading in all curriculum areas
 - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
 - Read both informational and fictional texts in a variety of genres and modes of discourse.
 - Read technical texts related to various subject areas.
- p. Discussing books
 - Discuss messages and themes from books in all subject areas.
 - Respond to a variety of texts in multiple modes of discourse.
 - Relate messages and themes from one subject area to messages and themes in another area.
 - Evaluate the merit of texts in every subject discipline.
 - Examine author's purpose in writing.
 - Recognize the features of disciplinary texts.
- q. Building vocabulary knowledge
 - Demonstrate an understanding of contextual vocabulary in various subjects.
 - Use content vocabulary in writing and speaking.
 - Explore understanding of new words found in subject area texts.
- r. Establishing context
 - Explore life experiences related to subject area content.

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- Discuss in both writing and speaking how certain words are subject area related.
- Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

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The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational

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structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY**

**CAREER PATHWAY:
COURSE TITLE:**

Welding VI

PREREQUISITE:

Welding V

COURSE DESCRIPTION: The goal of this course is to provide all students with the basic knowledge and safe operating skills in the use of Gas Tungsten Arc Welding equipment to produce fillet welds on aluminum in the flat (1F), horizontal (2F), and vertical (3F) positions. This course will also provide the student with the basic knowledge and skill necessary to prepare for welding certification. This course will build upon the skills acquired in previous welding courses. Minimum performance requirements for this course are based on successful student completion according to the American Welding Society (AWS) and the National Center for Construction Education and Research Center (NCCER) Occupation Standards. Students who successfully complete the course in accordance with NCCER standards are eligible for registration with the NCCER National Craft Worker Registry.

GTAW

ACCT-WVI-1. Students understand and setup equipment in a safe and correct manner.

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- a. Identify the parts of a G.T.A.W machine
- b. Demonstrate knowledge of equipment operation.
- c. Demonstrate safe operation of equipment.

Academic Standards:

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

- a. Follow correct procedures for use of scientific apparatus.
- b. Demonstrate appropriate techniques in all laboratory situations.
- c. Follow correct protocol for identifying and reporting safety problems and violations.

GTAW

ACCT-WVI-2 Students will produce fillet welds in the flat (1F) position

- c. Demonstrate producing fillet welds on aluminum.
- d. Identify possible weld defects and the causes in this position.

Academic Standards:

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.

GTAW

ACCT-WVI-3. Students will produce fillet welds in the horizontal (2F) position

- d. Demonstrate producing fillet welds on aluminum.
- e. Compare single and multiple pass welds in this position.
- f. Identify possible weld defects and the causes in this position.

Academic Standards:

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.

GTAW

ACCT-WVI-4. Students will produce fillet welds in the vertical (3F) position

- d. Demonstrate producing fillet welds on aluminum.

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- e. Compare single and multiple pass welds in this position.
- f. Identify possible weld defects and the causes in this position.

Academic Standards:

SC6. Students will understand the effects motion of atoms and molecules in chemical and physical processes.

- a. Compare and contrast atomic/molecular motion in solids, liquids, gases, and plasmas.

PREPARATION FOR CERTIFICATION

ACCT-WVI-5. Students will prepare test coupons to standards of the American Welding Society

- c. Demonstrate the ability to bevel coupons by either grinding, manual oxy-fuel cutting, or machine beveling on either carbon steel, stainless steel, or aluminum.
- d. Demonstrate proper fit up and tack weld on beveled coupons with or without backing strip.
- e. Perform simulated welding tests to A.W.S standards using any of the S.M.A.W., G.M.A.W, F.C.A.W., or G.T.A.W processes on either carbon steel, stainless steel or aluminum.
- f. Perform a guided bend test of any groove weld to meet A.W.S. standards and to the instructors approval.

Academic Standards:

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

- a. Develop and use systematic procedures for recording and organizing information.
- b. Use technology to produce tables and graphs.
- c. Use technology to develop, test, and revise experimental or mathematical models.

SCSh3. Students will identify and investigate problems scientifically.

- a. Suggest reasonable hypotheses for identified problems.
- b. Develop procedures for solving scientific problems.
- c. Collect, organize and record appropriate data.

Reading Across the Curriculum

Reading Standard Comment

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After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

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 - Read technical texts related to various subject areas.
- r. Discussing books
 - Discuss messages and themes from books in all subject areas.
 - Respond to a variety of texts in multiple modes of discourse.
 - Relate messages and themes from one subject area to messages and themes in another area.
 - Evaluate the merit of texts in every subject discipline.
 - Examine author's purpose in writing.
 - Recognize the features of disciplinary texts.
- s. Building vocabulary knowledge
 - Demonstrate an understanding of contextual vocabulary in various subjects.

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- Use content vocabulary in writing and speaking.
 - Explore understanding of new words found in subject area texts.
- t. Establishing context
- Explore life experiences related to subject area content.
 - Discuss in both writing and speaking how certain words are subject area related.
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CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

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CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation**

CAREER PATHWAY:

METALS TECHNOLOGY

COURSE TITLE:

Sheet Metal I

PREREQUISITE:
Metals

Introduction to

COURSE DESCRIPTION: This course is designed to allow students to master basic sheet metal techniques. This course includes the development of skills in basic trade math. Students will identify, rate, select, and use steel and other metals to develop and fabricate basic sheet metal projects. The course includes basic parallel line development and skills using fasteners, hangers, and other support systems. Minimum performance requirements for this course are based on successful student completion according to the National Center for Construction Education and Research Center (NCCER) Occupation

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Standards. Students who successfully complete the course in accordance with NCCER standards are eligible for registration with the NCCER Craft Worker Registry.

INTRO TO PARALLEL LINE DEVELOPMENT

ACCT-SMI-1 Students will demonstrate proficiency in parallel line development.

- a. Demonstrate an understanding of parallel line development as one of the three development methods for laying out sheet metal patterns.
- b. Demonstrate competency in parallel line development layout procedures.
- c. Demonstrate how to lay out patterns utilizing basic parallel line development.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- f. Determine the distance between two points.
- g. Determine the distance between a point and a line.
- h. Determine the midpoint of a segment.
- i. Understand the distance formula as an application of the Pythagorean theorem.
- j. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

MM1G3. Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.

- i. Determine the sum of interior and exterior angles in a polygon.
- j. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
- k. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
- l. Understand, use, and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
- m. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

MM2G1. Students will identify and use special right triangles.

- c. Determine the lengths of sides of 30° - 60° - 90° triangles.
- d. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM2G3. Students will understand the properties of circles.

- e. Understand and use properties of chords, tangents, and secants as an application of triangle similarity.
- f. Understand and use properties of central, inscribed, and related angles.

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- g. Use the properties of circles to solve problems involving the length of an arc and the area of a sector.
- h. Justify measurements and relationships in circles using geometric and algebraic properties.

MM2G4. Students will find and compare the measures of spheres.

- c. Use and apply surface area and volume of a sphere.
- d. Determine the effect on surface area and volume of changing the radius or diameter of a sphere.

MATH APPLICATIONS I

ACCT-SMI-2 Students will compute and solve mathematically, problems in sheet metal.

- a. Convert denominate numbers and multiply and divide them.
- b. Calculate successfully using various rule measurements.
- c. Calculate successfully using appropriate linear, square, weight, and volume measurements.
- d. Construct simple geometric figures and solve basic geometry problems that relate to the sheet metal trade.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- k. Determine the distance between two points.
- l. Determine the distance between a point and a line.
- m. Determine the midpoint of a segment.
- n. Understand the distance formula as an application of the Pythagorean theorem.
- o. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

MM1G3. Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.

- n. Determine the sum of interior and exterior angles in a polygon.
- o. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
- p. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
- q. Understand, use, and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
- r. Find and use points of concurrency in triangles: incenter, orthocenter,

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circumcenter, and centroid.

MM2G1. Students will identify and use special right triangles.

- e. Determine the lengths of sides of 30° - 60° - 90° triangles.
- f. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM2G3. Students will understand the properties of circles.

- i. Understand and use properties of chords, tangents, and secants as an application of triangle similarity.
- j. Understand and use properties of central, inscribed, and related angles.
- k. Use the properties of circles to solve problems involving the length of an arc and the area of a sector.
- l. Justify measurements and relationships in circles using geometric and algebraic properties.

MM2G4. Students will find and compare the measures of spheres.

- e. Use and apply surface area and volume of a sphere.
- f. Determine the effect on surface area and volume of changing the radius or diameter of a sphere.

FASTENERS, HANGERS, AND SUPPORTS

ACCT-SMI-3 Students will demonstrate the ability to use and identify fasteners, hangers, and supports.

- a. Identify the various kinds of fasteners used in sheet metal work.
- b. Use the right fasteners for the right job.
- c. Identify the various aspects of screw and bolt configurations.
- d. Describe some of the more common methods of supporting ducts.
- e. Identify the materials used for hanging and supporting ducts.
- f. Identify the factors that pertain to the selection and use of hangers and supports.
- g. Demonstrate skill in the installation of duct fasteners, hangers, and supports.

STEEL AND OTHER METALS

ACCT-SMI-4 Students will demonstrate the ability to identify and measure different types of metals used in sheet metal.

- a. State the difference between a pure metal and an alloy.
- b. List the eleven common properties of metals.
- c. State the chief types of metals.
- d. Measure the gage of sheet metal.

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Academic Standards:

SPS4. Students will investigate the arrangement of the Periodic Table.

- a. Determine the trends of the following:
 - Location of metals, nonmetals, and metalloids
- b. Use the Periodic Table to predict the above properties for representative elements.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

- s. Reading in all curriculum areas
 - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
 - Read both informational and fictional texts in a variety of genres and modes of discourse.
 - Read technical texts related to various subject areas.
- t. Discussing books

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- Discuss messages and themes from books in all subject areas.
 - Respond to a variety of texts in multiple modes of discourse.
 - Relate messages and themes from one subject area to messages and themes in another area.
 - Evaluate the merit of texts in every subject discipline.
 - Examine author's purpose in writing.
 - Recognize the features of disciplinary texts.
- u. Building vocabulary knowledge
- Demonstrate an understanding of contextual vocabulary in various subjects.
 - Use content vocabulary in writing and speaking.
 - Explore understanding of new words found in subject area texts.
- v. Establishing context
- Explore life experiences related to subject area content.
 - Discuss in both writing and speaking how certain words are subject area related.
 - Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

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CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY
Sheet Metal II**

CAREER PATHWAY:

COURSE TITLE:

**PREREQUISITE:
I**

Sheet Metal

Implementation date
Fall 2010

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COURSE DESCRIPTION: This course is designed to allow students to master basic sheet metal techniques by developing and fabricating basic sheet metal projects from blueprints and specifications and advanced parallel line development. Minimum performance requirements for this course are based on successful student completion according to the National Center for Construction Education and Research (NCCER) Occupation Standards. Students who successfully complete the course in accordance with the NCCER standards are eligible for registration with the NCCER National Craft Worker Registry.

ADVANCED PARALLEL LINE DEVELOPMENT

ACCT-SMII-1 Students will demonstrate proficiency in advanced parallel line development.

- a. Demonstrate an understanding of parallel line development as a method for fabricating sheet metal fittings and other items.
- b. Demonstrate the proper cutting and forming of basic patterns utilizing parallel line development.
- c. Correctly fabricate selected duct run fittings.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.
- b. Determine the distance between a point and a line.
- c. Determine the midpoint of a segment.
- d. Understand the distance formula as an application of the Pythagorean theorem.
- e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

MM1G3. Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.

- a. Determine the sum of interior and exterior angles in a polygon.
- b. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
- c. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
- d. Understand, use, and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
- e. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

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MM2G1. Students will identify and use special right triangles.

- a. Determine the lengths of sides of 30° - 60° - 90° triangles.
- b. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM2G3. Students will understand the properties of circles.

- a. Understand and use properties of chords, tangents, and secants as an application of triangle similarity.
- b. Understand and use properties of central, inscribed, and related angles.
- c. Use the properties of circles to solve problems involving the length of an arc and the area of a sector.
- d. Justify measurements and relationships in circles using geometric and algebraic properties.

MM2G4. Students will find and compare the measures of spheres.

- a. Use and apply surface area and volume of a sphere.
- b. Determine the effect on surface area and volume of changing the radius or diameter of a sphere.

BLUEPRINTS AND SPECIFICATIONS

ACCT-SMII-2 Students will demonstrate the ability to interpret blueprints and specifications.

- a. Demonstrate an ability to interpret blueprints and specifications.
- b. Demonstrate an ability to use section, elevation, and detail views or plans for interpreting drawings and blueprints.
- c. Demonstrate an ability to use mechanical, electrical, and plumbing drawings to interpret architectural information.
- d. Demonstrate an ability to use specifications for information pertaining to specific portions of the construction job.

BASIC PIPING PRACTICES

ACCT-SMI-3 Students will demonstrate the ability to identify and use various materials in basic piping.

- a. State the various materials for which pipe is made.
- b. List applications of various materials.
- c. List the common methods employed for joining pipe.
- d. List the common types of pipe hangers and supports

Reading Across the Curriculum

Reading Standard Comment

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Fall 2010

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After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

Reading in all curriculum areas

- Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
- Read both informational and fictional texts in a variety of genres and modes of discourse.
- Read technical texts related to various subject areas.

Discussing books

- Discuss messages and themes from books in all subject areas.
- Respond to a variety of texts in multiple modes of discourse.
- Relate messages and themes from one subject area to messages and themes in another area.
- Evaluate the merit of texts in every subject discipline.
- Examine author's purpose in writing.
- Recognize the features of disciplinary texts.

Building vocabulary knowledge

- Demonstrate an understanding of contextual vocabulary in various subjects.
- Use content vocabulary in writing and speaking.
- Explore understanding of new words found in subject area texts.

Establishing context

- Explore life experiences related to subject area content.

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- Discuss in both writing and speaking how certain words are subject area related.
- Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

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CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY
Sheet Metal III**

CAREER PATHWAY:

COURSE TITLE:

**PREREQUISITE:
II**

Sheet Metal

COURSE DESCRIPTION: This course is designed to allow students to master sheet metal practices in which they use advanced math to fabricate sheet metal ducts and roofing flashing as well as radial line development. Students will use Sheet Metal and Air Conditioning Contractors National Association (SMACNA) manuals for the standard that their project must meet. Minimum performance requirements for this course are based on successful student completion according to the National Center for Construction Education and Research Center (NCCER) Occupation Standards. Students who successfully complete the course in accordance with the NCCER standards are eligible for registration with the NCCER National Craft Worker Registry.

INTRO TO RADIAL LINE DEVELOPMENT

ACCT-SMIII-1 Students will demonstrate proficiency in radial line development.

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Describe the principles of radial line development used to determine layouts for sheet metal fittings.

Use the principles of radial line development for the layout of selected sheet metal fittings.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.
- b. Determine the distance between a point and a line.
- c. Determine the midpoint of a segment.
- d. Understand the distance formula as an application of the Pythagorean theorem.
- e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

MM1G3. Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.

- a. Determine the sum of interior and exterior angles in a polygon.
- b. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
- c. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
- d. Understand, use, and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
- e. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

MM2G1. Students will identify and use special right triangles.

- a. Determine the lengths of sides of 30° - 60° - 90° triangles.
- b. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM2G3. Students will understand the properties of circles.

- a. Understand and use properties of chords, tangents, and secants as an application of triangle similarity.
- b. Understand and use properties of central, inscribed, and related angles.
- c. Use the properties of circles to solve problems involving the length of an arc and the area of a sector.
- d. Justify measurements and relationships in circles using geometric and algebraic properties.

MM2G4. Students will find and compare the measures of spheres.

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- a. Use and apply surface area and volume of a sphere.
- b. Determine the effect on surface area and volume of changing the radius or diameter of a sphere.

MATH APPLICATIONS II

ACCT-SMIII-2 Students will compute and solve mathematically, problems in sheet metal.

- a. Perform mathematical tasks necessary for solving linear, area, volume, and angular measurement problems.
- b. Correctly apply mathematical symbols in the solution of mathematical problems.
- c. Solve percentage problems.
- d. Understand, define, and solve ratio and proportion problems and equations.
- e. Sequentially solve problems with the use of simple equations.
- f. Understand how to use protractors, vernier calipers, and micrometers for angle and tolerance measurement problems.
- g. Calculate the number of fitting blanks that can be cut from a given dimension of sheet metal stock.
- h. Calculate stretchouts of square fittings, rectangular fittings, rectangular box fittings, circular, and cone fittings.

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.
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MM2G4. Students will find and compare the measures of spheres.

- a. Use and apply surface area and volume of a sphere.
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THE SMACNA MANUALS

ACCT-SMIII-3 Students will demonstrate proficiency using SMACNA manuals locate information important to sheet metal fabrication.

- a. Demonstrate skill in locating standards for selected topics, fittings, or components.
- b. Define the difference between standards and codes or ordinances.
- c. Demonstrate skill in locating selected information in illustrations and tables.
- d. List other pertinent organizations that establish codes and standards.

ROOF FLASHING

ACCT-SMIII-4 Students will demonstrate proficiency in fabricating and installing various forms of roof flashings.

- a. Demonstrate skill in understanding the principles of weather sealing as they apply to architectural sheet metal work.
- b. Demonstrate skill in fabricating selected flashing components.
- c. Demonstrate skill in understanding installation procedures for selected chimney flashing members.

Reading Across the Curriculum

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Fall 2010

Reading Standard Comment

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- Discuss messages and themes from books in all subject areas.
- Respond to a variety of texts in multiple modes of discourse.
- Relate messages and themes from one subject area to messages and themes in another area.
- Evaluate the merit of texts in every subject discipline.
- Examine author’s purpose in writing.
- Recognize the features of disciplinary texts.

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- Demonstrate an understanding of contextual vocabulary in various subjects.
- Use content vocabulary in writing and speaking.
- Explore understanding of new words found in subject area texts.

Establishing context

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- Explore life experiences related to subject area content.
- Discuss in both writing and speaking how certain words are subject area related.
- Determine strategies for finding content and contextual meaning for unknown words.

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CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational

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structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY
Sheet Metal IV**

CAREER PATHWAY:

COURSE TITLE:

**PREREQUISITE:
III**

Sheet Metal

COURSE DESCRIPTION: This course is designed to allow students to master intermediate sheet metal practices by using advanced radial line development and the fabrication of gutters and downspouts. Minimum performance requirements for this course are based on successful student completion according to the National Center for Construction Education and Research (NCCER) Occupation Standards. Students who successfully complete the course in accordance with the NCCER standards are eligible for registration with the NCCER National Craft Worker Registry.

ADVANCED RADIAL LINE DEVELOPMENT

ACCT-SMIV-1 Students will demonstrate proficiency in advanced radial line development.

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- a. Demonstrate skill in the layout and fabrication of selected sheet metal fittings and related tasks.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.
- b. Determine the distance between a point and a line.
- c. Determine the midpoint of a segment.
- d. Understand the distance formula as an application of the Pythagorean theorem.
- e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

MM1G3. Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.

- a. Determine the sum of interior and exterior angles in a polygon.
- b. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
- c. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
- d. Understand, use, and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
- e. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

MM2G1. Students will identify and use special right triangles.

- a. Determine the lengths of sides of 30° - 60° - 90° triangles.
- b. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM2G3. Students will understand the properties of circles.

- a. Understand and use properties of chords, tangents, and secants as an application of triangle similarity.
- b. Understand and use properties of central, inscribed, and related angles.
- c. Use the properties of circles to solve problems involving the length of an arc and the area of a sector.
- d. Justify measurements and relationships in circles using geometric and algebraic properties.

MM2G4. Students will find and compare the measures of spheres.

- a. Use and apply surface area and volume of a sphere.
- b. Determine the effect on surface area and volume of changing the radius or diameter of a sphere.

GUTTERS AND DOWNSPOUTS

ACCT-SMIV-2 Students will demonstrate proficiency calculating and fabricating gutters and downspouts.

- a. Demonstrate skill in understanding the principles of roof design and drainage systems.
- b. Demonstrate skill in the calculating downspout and gutter sizes.
- c. Identify, lay out, and fabricate selected drainage components.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.
- b. Determine the distance between a point and a line.
- c. Determine the midpoint of a segment.
- d. Understand the distance formula as an application of the Pythagorean theorem.
- e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

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- c. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
- d. Understand, use, and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
- e. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

MM2G1. Students will identify and use special right triangles.

- a. Determine the lengths of sides of 30° - 60° - 90° triangles.
- b. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM2G3. Students will understand the properties of circles.

- a. Understand and use properties of chords, tangents, and secants as an application of triangle similarity.
- b. Understand and use properties of central, inscribed, and related angles.

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- c. Use the properties of circles to solve problems involving the length of an arc and the area of a sector.
- d. Justify measurements and relationships in circles using geometric and algebraic properties.

MM2G4. Students will find and compare the measures of spheres.

- a. Use and apply surface area and volume of a sphere.
- b. Determine the effect on surface area and volume of changing the radius or diameter of a sphere.

SHEET METAL DUCT FABRICATION STANDARDS

ACCT-SMIV-3 Students will demonstrate the ability to interpret, understand and use the sheet metal duct fabrication standards as they apply to sheet metal fabrication.

- a. Understand the effect of operating pressure on the design of a duct system.
- b. Determine sealing requirements for a selected ductrun by using reference charts and tables.
- c. Determine minimum gage requirements for selected ductruns by using reference charts and tables.
- d. Determine minimum connector and reinforcing requirements for selected ductruns by using reference charts and tables.
- e. Describe the purpose of a tie rod and determine when a tie rod is optional or mandatory by using reference charts and tables.
- f. Identify the different types of acceptable longitudinal seams, including application and any limitations.

BEND ALLOWANCES

ACCT-SMIV-4 Students will demonstrate proficiency in calculating and determining bend allowances on selected sheet metal problems.

- a. Describe the factors that influence bend allowances on sheet metal blanks.
- b. Demonstrate an understanding of the calculations necessary for determining proper bend allowances on selected sheet metal problems.
- c. Demonstrate skill in the determining bend allowances on selected sheet metal problems.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.
- b. Determine the distance between a point and a line.

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- c. Determine the midpoint of a segment.
- d. Understand the distance formula as an application of the Pythagorean theorem.
- e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

MM1G3. Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.

- e. Determine the sum of interior and exterior angles in a polygon.
- a. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
- b. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
- c. Understand, use, and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
- d. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

MM2G1. Students will identify and use special right triangles.

- a. Determine the lengths of sides of 30° - 60° - 90° triangles.
- b. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM2G3. Students will understand the properties of circles.

- a. Understand and use properties of chords, tangents, and secants as an application of triangle similarity.
- b. Understand and use properties of central, inscribed, and related angles.
- c. Use the properties of circles to solve problems involving the length of an arc and the area of a sector.
- d. Justify measurements and relationships in circles using geometric and algebraic properties.

MM2G4. Students will find and compare the measures of spheres.

- a. Use and apply surface area and volume of a sphere.
- b. Determine the effect on surface area and volume of changing the radius or diameter of a sphere.

Reading Across the Curriculum

Reading Standard Comment

After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning

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(language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAE-RC-1 Students will enhance reading in all curriculum areas by:

Reading in all curriculum areas

- Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
- Read both informational and fictional texts in a variety of genres and modes of discourse.
- Read technical texts related to various subject areas.

Discussing books

- Discuss messages and themes from books in all subject areas.
- Respond to a variety of texts in multiple modes of discourse.
- Relate messages and themes from one subject area to messages and themes in another area.
- Evaluate the merit of texts in every subject discipline.
- Examine author's purpose in writing.
- Recognize the features of disciplinary texts.

Building vocabulary knowledge

- Demonstrate an understanding of contextual vocabulary in various subjects.
- Use content vocabulary in writing and speaking.
- Explore understanding of new words found in subject area texts.

Establishing context

- Explore life experiences related to subject area content.
- Discuss in both writing and speaking how certain words are subject area related.

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- Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

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corporations and comprehend their importance to organizational performance and regulatory compliance.

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CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications & Transportation
METALS TECHNOLOGY
Sheet Metal V**

CAREER PATHWAY:

COURSE TITLE:

PREREQUISITE:

IV

Sheet Metal

COURSE DESCRIPTION: This course identifies the principles of air flow and includes the development of skills in such areas as using associated equipment to measure and do field measuring related to the sheet metal and HVACR industries. Students will also use triangulation to fabricate various sheet metal projects. Minimum performance requirements for this course are based on successful student completion according to the National Center for Construction Education and Research (NCCER) Occupation Standards. Students who successfully complete the course in accordance with the NCCER standards are eligible for registration with the NCCER National Craft Worker Registry.

TRIANGULATION

ACCT-SMV-1 Students will demonstrate proficiency using the principles of triangulation in the development and fabrication of selected ductrun fittings and related tasks.

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- a. Describe the principles of triangulation used to determine measurements for ductrun fittings.
- b. Use the principles of triangulation for laying out selected ductrun fittings.
- c. Demonstrate skill in the development, layout, and fabrication of selected ductrun fittings and related tasks.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.
- b. Determine the distance between a point and a line.
- c. Determine the midpoint of a segment.
- d. Understand the distance formula as an application of the Pythagorean theorem.
- e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

MM1G3. Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.

- a. Determine the sum of interior and exterior angles in a polygon.
- b. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
- a. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
- b. Understand, use, and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
- c. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

MM2G1. Students will identify and use special right triangles.

- a. Determine the lengths of sides of 30° - 60° - 90° triangles.
- b. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM2G3. Students will understand the properties of circles.

- a. Understand and use properties of chords, tangents, and secants as an application of triangle similarity.
- b. Understand and use properties of central, inscribed, and related angles.
- c. Use the properties of circles to solve problems involving the length of an arc and the area of a sector.
- d. Justify measurements and relationships in circles using geometric and algebraic properties.

MM2G4. Students will find and compare the measures of spheres.

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- a. Use and apply surface area and volume of a sphere.
- b. Determine the effect on surface area and volume of changing the radius or diameter of a sphere.

PRINCIPLES OF AIRFLOW

ACCT-SMV-2 Students will demonstrate the ability to understand the design and sizing of duct run as it relates to principles of air flow.

- a. Explain the principles of airflow that affect the design and sizing of duct run systems.
- b. Identify the components of an air distribution system.
- c. Define the terms related to airflow in ducts.
- d. Understand the effects of duct sizes, duct shapes, and duct fittings on airflow.

FIELD MEASURING AND FITTING

ACCT-SMV-3 Students will demonstrate the ability to apply field measuring and fitting techniques used for layout of duct runs and fittings.

- a. Describe common practices used for field measuring and layout of duct runs and fittings.
- b. Demonstrate competence in solving selected field measuring problems.
- c. Apply standard rules and practice for solving selected field measurement problems.

Reading Across the Curriculum

Reading Standard Comment

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academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

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- Discuss messages and themes from books in all subject areas.
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- Evaluate the merit of texts in every subject discipline.
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- Recognize the features of disciplinary texts.

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- Demonstrate an understanding of contextual vocabulary in various subjects.
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- Explore understanding of new words found in subject area texts.

Establishing context

- Explore life experiences related to subject area content.
- Discuss in both writing and speaking how certain words are subject area related.
- Determine strategies for finding content and contextual meaning for unknown words.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

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The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

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CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the

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workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.

PROGRAM CONCENTRATION:

**Architecture, Construction,
Communications &**

Transportation

CAREER PATHWAY:

METALS TECHNOLOGY

COURSE TITLE:

Sheet Metal VI

PREREQUISITE:

Sheet Metal

V

COURSE DESCRIPTION: This course identifies and explains the importance of shop production and organization. This course includes the development of skills use in fabrication principles dealing with louvers, dampers, hoods, ventilators, and access doors used for air balance in various system designs. Minimum performance requirements for this course are based on successful student completion according to the National Center for Construction Education and Research (NCCER) Occupation Standards. Students who successfully complete the course in accordance with the NCCER standards are eligible for registration with the NCCER National Craft Worker Registry.

SHOP PRODUCTION AND ORGANIZATION

ACCT-SMVI-1 Students will demonstrate the ability to maximize shop production in safe and orderly manner.

- a. Outline the procedure necessary for planning the workday.
- b. Identify the factors that affect speed, efficiency, and minimum waste of material.
- c. Describe methods of utilizing scrap metal.
- d. Explain how shop assignment procedures are organized.
- e. Outline a typical job planning and production flow for a sheet metal production shop.
- f. Describe how to coordinate sheet metal work with other trades.
- g. Explain how to project manpower and material costs.
- h. Identify a procedure for utilizing manpower effectively.
- i. Describe the role relationships between the supervisory and production staff for a typical sheet metal shop operation.

LOUVERS, DAMPERS, AND ACCESS DOORS

ACCT-SMVI-2 Students will demonstrate proficiency layout and fabricating various types of louvers, dampers, and access doors.

- a. Explain the purpose of selected louvers, dampers, and access doors.
- b. Describe the procedures necessary for fabrication of selected louvers, dampers, and access doors.
- c. Demonstrate competence in the layout, development, and fabrication of selected louvers, dampers, and access doors.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- a. Determine the distance between two points.
- b. Determine the distance between a point and a line.
- c. Determine the midpoint of a segment.
- d. Understand the distance formula as an application of the Pythagorean theorem.
- e. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

MM1G3. Students will discover, prove, and apply properties of triangles, quadrilaterals, and other polygons.

- a. Determine the sum of interior and exterior angles in a polygon.
- b. Understand and use the triangle inequality, the side-angle inequality, and the exterior-angle inequality.
- c. Understand and use congruence postulates and theorems for triangles (SSS, SAS, ASA, AAS, HL).
- d. Understand, use, and prove properties of and relationships among special quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
- e. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

MM2G1. Students will identify and use special right triangles.

- a. Determine the lengths of sides of 30° - 60° - 90° triangles.
- b. Determine the lengths of sides of 45° - 45° - 90° triangles.

MM2G3. Students will understand the properties of circles.

- a. Understand and use properties of chords, tangents, and secants as an application of triangle similarity.

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- b. Understand and use properties of central, inscribed, and related angles.
- c. Use the properties of circles to solve problems involving the length of an arc and the area of a sector.
- d. Justify measurements and relationships in circles using geometric and algebraic properties.

MM2G4. Students will find and compare the measures of spheres.

- a. Use and apply surface area and volume of a sphere.
- b. Determine the effect on surface area and volume of changing the radius or diameter of a sphere.

COMPREHENSIVE REVIEW

ACCT-SMVI-3 Students will demonstrate the ability to select and use parallel line development, radial line development, and triangulation in the fabrication of various sheet metal fittings.

- a. Demonstrate understanding of parallel line development, radial line development, and triangulation as the three development methods for laying out sheet metal patterns.
- b. Demonstrate skill in the layout and fabrication of selected sheet metal fittings by using the most suitable development method.
- c. Develop knowledge of shortcuts in fabrication.

Academic Standards:

MM1G1. Students will investigate properties of geometric figures in the coordinate plane.

- f. Determine the distance between two points.
- g. Determine the distance between a point and a line.
- h. Determine the midpoint of a segment.
- i. Understand the distance formula as an application of the Pythagorean theorem.
- j. Use the coordinate plane to investigate properties of and verify conjecture related to triangles and quadrilaterals.

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quadrilaterals: parallelogram, rectangle, rhombus, square, trapezoid, and kite.

- j. Find and use points of concurrency in triangles: incenter, orthocenter, circumcenter, and centroid.

MM2G1. Students will identify and use special right triangles.

- c. Determine the lengths of sides of 30° - 60° - 90° triangles.
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MM2G3. Students will understand the properties of circles.

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FUME AND EXHAUST SYSTEMS DESIGN

ACCT-SMVI-4 Students will demonstrate the ability to lay out, fabricate, and install fume or exhaust systems according to codes and specifications.

- a. Describe how to interpret codes and specifications pertaining to selected fume or exhaust systems.
- b. Select appropriate materials for fabrication of identified exhaust or fume systems or components.
- c. Lay out, fabricate, and install selected fume or exhaust systems or components.

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