Course of Study

Welding

Warren County Career Center

3525 North State Route 48
Lebanon, Ohio 45036

Adopted June 17, 2010

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Acknowledgements

Welding
Warren County Career Center

We would like to take this opportunity to express our gratitude to the following people for their guidance and support in the preparation of this course of study:

Warren County Career Center Administrative Team
Warren County Educational Service Center
Acknowledgements

Warren County Career Center
Resolution Of School Board Approval

WHEREAS, representatives of Welding Department of the Warren County Career Center have reviewed the English Application in Drama Course of Study; and

WHEREAS, this Course of Study is based upon Integrating Technical and Academic Competencies adopted by the State of Ohio for the Welding program; and

WHEREAS, the Welding faculty and the Career-Technical Advisory Committee have reviewed and added competencies as needed to address local labor market needs and trends in the industry;

NOW, THEREFORE, BE IT RESOLVED, in accordance with the Superintendent's recommendation, that the Warren County Career Center adopt the Welding Course of Study.

_____

District Superintendent Date

_____

President, Board of Education Date

Statement of Recommendation

The Welding Advisory Committee at Warren County Career Center has reviewed this course of study and recommends it for use as the foundation for instruction in the Welding class.

The developers of this course of study have considered local labor market needs and the school's ability to offer specialized programs. The competencies have been reviewed and accepted as being congruent with our school's vision, mission, and strategic goals. When appropriate, additional competencies related to the program area have been incorporated into this course of study.

Achievement of technical competencies, utilizing proper attitudes, and demonstrating appropriate values are critical for successful employment and for furthering educational opportunities within a student's chosen field. We believe that this course of study adequately and correctly focuses upon student development.

This course of study is recommended on: June 17, 2010

Warren County Career Center Vision Statement

WCCC is the valued partner of choice within the educational and economic systems of our communities, by providing quality academic and career technical education.

We pave the way for a future of opportunities unique to each of our learners.

Warren County Career Center Mission Statement

To prepare youths and adults to make informed career choices and to successfully enter, compete, and advance in a changing work world.

Warren County Career Values

- Treating each other with respect, dignity, trust and mutual value
- Communicating openly and honestly
- Taking ownership of personal actions and being held accountable for results
- Upholding and demonstrating high ethical, educational and fiscal standards
- Exhibiting high levels of professionalism
- Providing high quality instruction and highly qualified staff to ensure success for all learners
- Making quality customer service a high priority
- Promoting partnerships and a team environment
- Celebrating team and individual achievements
- Using data to drive planning, decision making and actions
- Embracing educational opportunities for change and diversity

Course Design

Courses are designed to reflect career-focused education, which combines high-level academics with real-life technical skills. The intent is to maximize a student's present and future academic and career success.

Career-focused education enhances the integration of academic and technical skills, designs programs that prepare students with transferable skills and promotes each student's career opportunities.

Course Philosophy

We believe that the ever-expanding technology and growth of welding trades and the industrial expansion around the world, great demands will need to be met for the supply of young people with technical knowledge and develoed manual skills in the welding and metal fabrication trades.

I believe that vocational welding and metal fabrication programs will supply the community, country and area with young people with pride, honesty, integrity, safe working habits, and entry level skills.

I believe the community and country will benefit by this quality of student.

Course Goals

The course goals for Welding are to:

1. Demonstrate skill and technical knowledge in entry-level employment in welding and metals fabrication and related fields.
2. Safely use hand tools and power equipment necessary in welding and metals fabrication and related fields.
3. Exhibit knowledge in employment practices in order to succeed on the job.
4. Demonstrate the necessary technical knowledge in comprehension of scientific, mathematic, and mechanical principles to form sound trade judgement.
5. Exhibit safety awareness. Which is reflected in good work habits, including cleanliness, order, and safety habits.
6. Demonstrate the qualities of leadership for effective participation in the various organizations affiliated with welding and metals fabrication.
7. Exhibit qualities of self-confidence, initiative, excellence in performance, a cooperative attitude, and an appreciation for craftsmanship as is needed for successful employment in the welding and metals fabrication trade.
8. Perform operations in hand and machine, burning and hard facing to meet the established entry level-standards.
9. Demonstrate the ability to arc weld and oxyacetylene weld structural shapes to meet the entry-level standards for fracture and guided bend test.
10. Demonstrate the ability in tungsten inert gas welding on ferrous and non-ferrous as well as semiautomatic inert gas and flux cored wire processes to meet established entry trade level standards.
11. Exhibit an awareness and an understanding of the necessity and value of continuing education.
12. Placement of every graduate in entry employment or post high school education.
13. Career orientation for K-8 students.
14. Career exploration for 7-10th grade students.
15. Occupational cluster opportunities for senior high school students.
16. Specific occupational training opportunities for post secondary and adult students.
17. Improvement of social behavior and pride in our community, state, and national government.

Course Description

The Welding program at Warren County Career Center is designed to give the student, over a two-year period of time, 920 hours of practical training in the welding and metal fabrication area. Each class consists of 2 1/2 hours in laboratory. At the end of these two years, the student will have received enough training in manipulative activities and related technology to acquire a job as an advanced learner in the welding and metal fabrication field.

Warren County is located in Southwestern Ohio, populated by, to a large extent, skilled and semiskilled, and blue-collar workers. The Warren County Career Center has a present enrollment of 680 students in grades 11 and 12.

Academic and Technical Integration

Expectations of curriculum must be aligned with what is written, taught, assessed, and reported. Student expectations focus on active, project-centered learning—an approach to learning that emphasizes a connection between ideas in a discipline and the outside world. Educational programming and course content will clearly connect career and post-secondary opportunities. At the Warren County Career Center, the main goal is to design courses and projects that use strategies for authentic instruction. These characteristics of instruction focus on deep understanding, established opportunities for concept connections, provide anticipatory and abstract thinking, and emphasize genuine application.

The academic courses at the WCCC follow the state model curricula. They are designed to meet both associate school and state requirements. These standards respond to the need to improve student achievement, quality of curriculum and instruction, and strengthen school and community relationships.

Technology

The Warren County Career Center board and staff believe that technology skills are essential for all students to achieve in the 21st century. It is the goal of this district to infuse technology into all facets of education:

- Instruction
- Assessment
- Administration
- Career planning
- Course design
- Professional development

Strategies to incorporate technology into all facets of education are a priority of the district and there is commitment to a continual process to provide updated hardware, software, and professional development for staff members for the purpose of providing a high quality education, with the integration of technology, for all students.

Job Shadowing

Job Shadowing is designed to give the student a short-term overview of the many opportunities within a career field. Career-technical instructors confer with students to determine appropriate experiences.

Internships and Job Placement vary somewhat, but during each experience students should accomplish the following goals:

1. Work with mentors, supervisors, co-workers, and others to accomplish assigned tasks that contribute to the long- and short-term goals of the student. All aspects of the internship/placement (including dates, times, responsibilities, evaluations, etc.) will be outlined in an approved Internship Learning Plan that is coordinated by the career-technical instructor.

2. Apply basic skills and knowledge to "real world" business settings and learn new skills that are relevant to the career path.

3. Demonstrate a solid understanding of the basic skills outlined in the Internship Learning Plan.

4. Reflect upon the internship/placement/job shadowing in terms of post-secondary education/career options.

The criterion for participation in career-based learning experiences is included in the approved packet for each activity and may be obtained by the instructor from the Career Pathways office.

The specifics of how these opportunities are offered in this career-technical program or statement of academic support are:

Students that meet the requirements set forth by the Early Placement Committee are eligible to work with local businesses during the second semester of their senior year. This allows the student to work during designated lab time with the approval of the Instructor. The Instructor will monitor academic eligibility along with the status of their field progress using contractor evaluations. In addition, parent approval and a written contract with the student for certain goals to be achieved will be required.

Students Served

The population served by this program is juniors and seniors.

Scope and Sequence

Competency		12	AD	ApT	BIL
MANUFACTURING TECHNOLOGIES CORE BODY OF KNOWLEDGE					
Unit 1: Career Exploration and Development					
1.1	Explore career pathways in manufacturing technology.	P	R	R	E
1.2	Explore professional development and career advancement opportunities for a manufacturing technology professional.	P	R	R	E
1.3	Explain apprenticeships and their role in the manufacturing industry.	I	P	R	E
1.4	Demonstrate positive work behaviors and personal qualities.	P	R	R	E
1.5	Develop personal career goals and the objectives to meet those career goals.	P	R	R	E
Unit 2: Business Processes					
2.1	Develop a business process model for manufacturing operations.	I	P	R	E
2.2	Analyze the manufacturing industry.	I	P	R	R
2.3	Analyze trends and issues in the manufacturing industry.	I	P	R	E
2.4	Explain how planning and budgeting are used to accomplish organizational goals and objectives.	I	P	R	R
2.5	Explain material control and product inventories necessary to meet customer and business requirements.	I	P	R	E
2.6	Benchmark financial and market performance against competitors.	I	P	R	E
2.7	Explain how changes outside manufacturing impact the manufacturing process.	I	P	R	E
2.8	Explain the role of risk management in reducing risks and improving performance in manufacturing businesses.	I	I	R	R
2.9	Explain the roles and functions of government in regulating and supporting manufacturing business.	I	I	I	R
2.10	Explain how manufacturing businesses manage customer relationships.	I	I	I	R
2.11	Develop a management plan for business.	I	I	R	R
2.12	Identify basic procedures in the accounting cycle.	I	P	P	E
Unit 3: Communications					
3.1	Apply active listening skills to obtain and clarify information provided in oral communications.	P	R	R	E
3.2	Listen and speak effectively to contribute to group discussions and meetings.	P	R	R	E
3.3	Deliver formal and informal presentations that demonstrate organization and delivery skill.	P	R	R	E
3.4	Write and utilize coherent and focused technical communications that support a defined perspective.	P	R	R	E
3.5	Employ information technology applications.	I	P	P	E
3.6	Use written documents to direct the work.	I	P	R	E
3.7	Explain the fundamentals of manufacturing drawings, schematics, specifications and diagrams.	P	R	R	E
3.8	Research and respond to customer needs.	I	P	R	E
Unit 4: Problem Solving and Critical Thinking					
4.1	Employ critical thinking and problem solving skills independently or in teams to formulate solutions to problems.	I	P	P	E

Competency		12	AD	ApT	BIL
4.2	Apply problem solving and critical thinking techniques to the conflict between available resources, requirements of the project and manufacturing timelines.	I	P	P	E
4.3	Combine critical thinking and team building skills to solve problems.	I	P	P	E
4.4	Evaluate and adjust plans and schedules to respond to unexpected events and conditions.	I	P	P	E
Unit 5: Leadership and Teamwork					
5.1	Summarize the interpersonal skills that contribute to positive leadership and teamwork.	I	P	R	E
5.2	Demonstrate the ability to work on a team and recognize the importance of teamwork and its impact on business in a manufacturing environment.	P	R	R	E
5.3	Perform responsibly as a team member.	P	R	R	E
5.4	Use motivational techniques to enhance performance in others.	I	P	R	E
5.5	Describe the basic origins of conflict and the needs that motivate behavior.	P	R	R	E
5.6	Examine the different responses to conflict as they relate to results.	P	R	R	E
5.7	Resolve conflicts to maintain a smooth workflow.	P	R	R	E
Unit 6: Legal and Ethical Aspects					
6.1	Differentiate between legal and ethical issues.	I	P	R	E
6.2	Complete work-related duties within an ethical framework.	I	P	P	E
6.3	Assess the implications of ethical and unethical behavior.	P	R	R	E
6.4	Perform duties according to laws, regulations, contract provisions and policies.	I	P	R	E
6.5	Comply with applicable government regulations and codes.	I	P	P	E
6.6	Explain employee and employer liability.	I	P	R	E
Unit 7: Safety					
7.1	Maintain general safety in accordance with government regulations, health standards and company policy.	P	R	R	E
7.2	Evaluate the ergonomic factors associated with the manufacturing industry.	P	R	R	E
7.3	Identify state, federal and local worker safety, health and environmental regulations.	I	P	P	E
7.4	Demonstrate practices that contribute to an accident-free environment.	P	R	R	E
7.5	Explain emergency response plans in a variety of industrial settings.	P	R	R	E
7.6	Complete requirements for First Aid and CPR certification.	I	I	I	R
7.7	Complete and apply operations and safety training on all equipment.	P	R	R	E
Unit 8: Health and Environment					
8.1	Identify practices that contribute to a healthy environment.	P	R	R	E
8.2	Explain the environmental aspects of worksites with contaminated waste.	I	I	P	R
8.3	Handle hazardous materials in accordance with government regulations and health standards.	P	R	R	E
8.4	Identify the relationship between production processes and human health and environmental problems.	I	P	P	E
Unit 9: Tools and Equipment					
9.1	Identify basic tools and equipment appropriate to manufacturing.	P	R	R	E

Competency		12	AD	ApT	BIL
9.2	Demonstrate appropriate use of basic hand tools to complete work functions.	P	R	R	E
9.3	Operate power tools and stationary equipment.	P	R	R	E
9.4	Maintain hand and power tools appropriate to manufacturing.	P	R	R	E
9.5	Use appropriate personal protective equipment (PPE).	P	R	R	E
Unit 10: Manufacturing Technology Basics					
10.1	Evaluate products in relation to size, proportion and tolerances.	P	R	R	E
10.2	Interpret drawings, prints and schematics.	P	R	R	E
10.3	Demonstrate basic drawing skills.	I	P	R	E
10.4	Describe basic electrical and electronic theory.	I	P	R	E
10.5	Identify voltage, current, resistance, charge and load using electrical test equipment.	I	P	R	E
10.6	Describe basic hydraulic and pneumatic systems.	I	P	R	E
10.7	Describe fluid flow concepts.	I	P	R	E
10.8	Describe welding procedures for metals and plastics.	I	P	P	E
10.9	Describe materials joining procedures.	I	P	P	E
10.10	Identify machining procedures for metals and plastics.	I	P	P	E
10.11	Describe the application of basic mechanical physics.	P	R	R	E
10.12	Describe plastic processing and compounding.	I	P	R	E
10.13	Identify materials for type and quality.	I	P	P	E
10.14	Practice preventive and predictive maintenance in accordance with guidelines specified by manufacturers and/or outside authorities with jurisdiction.	I	P	P	E
10.15	Explain the impact of emerging technologies in manufacturing.	I	P	R	E
10.16	Describe basic metallurgy and metal processing.	I	P	R	E
Welding					
Unit 11: Safety					
11.1	Describe fumes, gases and toxic materials.	P	R		E
11.2	Demonstrate gas storage safety.	P	R		E
11.3	Demonstrate fire safety.	P	R		E
Unit 12: Materials Science, Inspection and Testing					
12.1	Assess materials.	P	R		E
12.2	Explain weld testing.	P	R		E
12.3	Predict degree of distortion.	P	R		E
Unit 13: Engineering Drawings					
13.1	Describe and interpret welding symbols and definitions.	P	R		E
13.2	Interpret Drawings and Prints.	P	R		E
13.3	Explain welding procedure specifications.	P	R		E
13.4	Select and utilize measuring devices.	P	R		E
Unit 14: Welding Fabrication					
14.1	Demonstrate power metalworking machinery.	P	R		E
14.2	Construct simple weldments from drawings.	P	R		E
Unit 15: Oxyfuel Brazing and Soldering					
15.1	Explain oxyfuel brazing and soldering.	P	R		E
15.2	Demonstrate oxyfuel brazing and soldering.	P	R		E
Unit 16: Shielded Metal Arc Welding (SMAW)					
16.1	Explain the SMAW process.	P	R		E
16.2	Demonstrate SMAW of mild steel plate.	P	R		E
16.3	Demonstrate SMAW of stainless steel.	I	P		R
16.4	Demonstrate SMAW of mild steel pipe.	I	P		R

Competency		12	AD	ApT	BIL
16.5	Describe SMAW hardfacing.	I	P		R
16.6	Describe SMAW of cast iron.	I	P		R
Competency		**12**	**AD**	**ApT**	**BIL**
Unit 17: Thermal Cutting					
17.1	Demonstrate cutting metals using the plasma arc cutting (PAC) process.	P	R		E
17.2	Explain cutting and gouging metals using the air carbon arc (CAC-A) process.	P	R		R
17.3	Demonstrate cutting metals using manual and machine-guided oxyfuel processes.	P	R		E
17.4	Explain advanced cutting systems.	I	I		R
Unit 18: Gas Metal Arc Welding (GMAW)					
18.1	Explain the GMAW process.	P	R		E
18.2	Demonstrate GMAW of mild steel.	P	R		E
18.3	Demonstrate GMAW of stainless steel.	I	P		R
18.4	Demonstrate GMAW of aluminum.	I	P		R
18.5	Demonstrate GMAW of mild steel pipe.	I	P		R
Unit 19: Flux Core Arc Welding (FCAW)					
19.1	Explain the FCAW process.	P	R		E
19.2	Demonstrate FCAW of mild steel.	P	R		E
19.3	Demonstrate FCAW of stainless steel.	I	P		R
Unit 20: Gas Tungsten Arc Welding (GTAW)					
20.1	Explain the GTAW process.	P	R		E
20.2	Demonstrate GTAW of mild steel.	P	R		E
20.3	Demonstrate GTAW of stainless steel.	P	R		E
20.4	Demonstrate GTAW of aluminum.	P	R		E
20.5	Demonstrate GTAW of mild steel pipe.	I	P		R
Unit 21: Advanced Welding Systems					
21.1	Discuss trends, issues and impacts of emerging technologies in welding.	I	P		R
21.2	Explain advanced welding systems.	I	P		R

Unit 1: Career Exploration and Development

BIL **Essential**

	12	AD	ApT
EDU:	**P**	R	R

Competency 1.1: Explore career pathways in manufacturing technology.

Descriptors:

1.1.1 Identify current and future career options in manufacturing technology.

1.1.2 Research the historical evolution of the various careers in manufacturing technology.

1.1.3 Experience specific manufacturing interests (e.g., shadowing, professional readings, community service, internship).

1.1.4 Identify education and training needed for a career in manufacturing technology.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Formulate open-ended research questions suitable for investigation and adjust questions as necessary while research is conducted.* (Research A, 8-10)
- *Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted.* (Research A, 11-12)
- *Evaluate the usefulness and credibility of data and sources.* (Research B, 8-10)
- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

Correlated Science Academic Content Benchmarks

- *Recognize that scientific literacy is part of being a knowledgeable citizen.* (Scientific Ways of Knowing D, 9-10)
- *Explain how societal issues and considerations affect the progress of science and technology*. (Scientific Ways of Knowing C, 11-12)

BIL: **Essential**

	12	AD	ApT
EDU:	**P**	R	R

Competency 1.2: Explore professional development and career advancement opportunities for a manufacturing technology professional.

Descriptors:

1.2.1 Identify advancement opportunities in manufacturing technology (e.g., internal and external).

1.2.2 Research continuing education courses or programs available to enhance skills, to remain current in the profession, and for career advancement (e.g., governing organizations and requirements).

1.2.3 Describe the importance of professional organizations, associations, trades shows, seminars and professional relationships with manufacturing technology professionals.

1.2.4 Remain current on changes in the manufacturing technology profession.
1.2.5 Demonstrate quality work as measured by performance evaluations.
1.2.6 Maintain a résumé, a list of references, and a portfolio.
1.2.7 Prepare for job interviews.

Correlated English Language Arts Academic Content Benchmarks

- *Produce letters (e.g., business, letters to the editor, job applications) that follow the conventional style appropriate to the text and that include appropriate details and exclude extraneous details and inconsistencies.* (Writing Applications C, 8-10)
- *Formulate open-ended research questions suitable for investigation and adjust questions as necessary while research is conducted.* (Research A, 8-10)
- *Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted.* (Research A, 11-12)
- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)
- *Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	R

Competency 1.3: **Explain apprenticeships and their role in the manufacturing industry.**
Descriptors:
1.3.1 Define apprentice, apprenticeships and apprenticeable occupations (e.g., welder, machinist, industrial electrician).
1.3.2 Define journeyperson and indentured.
1.3.3 Contrast registered and non-registered apprenticeships.
1.3.4 Distinguish related instruction from on-the-job training in an apprenticeship pathway.

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots and affixes to determine the meanings of complex words and subject area vocabulary.* (Acquisition of Vocabulary E, 8-10)
- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia.* (Research E, 8-10; Research E, 11-12)

BIL: **Essential**

	12	AD	ApT
EDU:	P	R	R

Competency 1.4: **Demonstrate positive work behaviors and personal qualities.**
Descriptors:
1.4.1 Conform to company and departmental policies (e.g., attendance, punctuality, time management).

1.4.2 Demonstrate professionalism, self-discipline, self-worth, positive attitude and integrity in a work situation.
1.4.3 Demonstrate flexibility and willingness to learn.
1.4.4 Exhibit a commitment to the organization.
1.4.5 Explain how individuals impact manufacturing performance.
1.4.6 Describe the expectations for individuals in terms of manufacturing performance.
1.4.7 Identify impact areas of individual performance (e.g., quality, profit, customer relations).
1.4.8 Discuss the importance of having all individuals understanding the core business processes of manufacturing organizations.

Correlated English Language Arts Academic Content Benchmarks

- *Give presentations using a variety of delivery methods, visual displays and technology.* (Communication: Oral and Visual G, 8-10; Communication: Oral and Visual F, 11-12)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	P	R	R

Competency 1.5: Develop personal career goals and the objectives to meet those career goals.

Descriptors:
1.5.1 Explore career opportunities in manufacturing technology.
1.5.2 Identify the educational and professional requirements for each career opportunity.
1.5.3 Demonstrate the ability to seek and apply for employment.
1.5.4 Demonstrate ability to evaluate and compare employment opportunities and accept employment.

Correlated English Language Arts Academic Content Benchmarks

- *Produce letters (e.g., business, letters to the editor, job applications) that follow the conventional style appropriate to the text and that include appropriate details and exclude extraneous details and inconsistencies.* (Writing Applications C, 8-10)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)
- *Evaluate the usefulness and credibility of data and sources.* (Research B, 8-10)
- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

Unit 2: Business Processes

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

EDU:	12	AD	ApT
	I	P	R

Competency 2.1: Develop a business process model for manufacturing operations.

Descriptors:

2.1.1 Define business processes.

2.1.2 Identify and explain the core business processes in manufacturing (e.g., product development, sourcing and planning, manufacturing and logistics).

2.1.3 Prepare a diagram, chart and/or model that illustrates the manufacturing business processes.

2.1.4 Prepare a diagram, chart and/or model that illustrates one segment of the manufacturer's business processes (e.g., new product design and development).

2.1.5 Illustrate manufacturing strategies and tactics in the business process model.

2.1.6 Trace and evaluate the interrelated activities performed to produce a product and serve a customer.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)
- *Give presentations using a variety of delivery methods, visual displays and technology.* (Communication: Oral and Visual F, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Translate information from one representation (words, table, graph or equation) to another representation of a relation or function.* (Patterns, Functions and Algebra C, 8-10)
- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)
- *Construct convincing arguments based on analysis of data and interpretation of graphs*. (Data Analysis and Probability F, 8-10)

BIL: Recommended

EDU:	12	AD	ApT
	I	P	R

Competency 2.2: Analyze the manufacturing industry.

Descriptors:

2.2.1 Categorize manufactured goods by type (e.g., medical, petroleum, metal).

2.2.2 Identify and describe types of manufacturing systems.

2.2.3 Identify the customers, suppliers and stakeholders, and describe their roles and how they relate.

2.2.4 Explain the impact of long term goals and planning on organization success.
2.2.5 Explain the major competitive challenges faced by manufacturing businesses.
2.2.6 Describe historical influences on manufacturing (e.g., the labor movement, foreign competition, high performance, quality).

Correlated English Language Arts Academic Content Benchmarks

- *Examine the relationships of analogical statements to infer word meanings.* (Acquisition of Vocabulary B, 8-10)
- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)
- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data Analysis and Probability A, 8-10)
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretation of solution within the model, and validation to original problem situation.* (Mathematical Processes J, 11-12)

BIL: Essential

EDU:	**12**	**AD**	**ApT**
	I	P	R

Competency 2.3: Analyze trends and issues in the manufacturing industry.
Descriptors:
2.3.1 Explain economic, labor and environmental factors related to manufacturing.
2.3.2 Explain quality assurance systems and how they contribute to effective work organizations.
2.3.3 Explain foreign out-sourcing and its impact on the national economy.
2.3.4 Describe productivity issues related to manufacturing. (e.g., scrap, employee productivity, quality)
2.3.5 Identify technological advancements and describe how they have influenced manufacturing processes.
2.3.6 Explain the cost and benefits of technological innovations.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10**)**
- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Connect statistical techniques to applications in workplace and consumer situations.* (Data Analysis and Probability D, 11-12)
- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

Correlated Science Academic Content Benchmarks

- *Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)
- *Explain that science and technology are interdependent; each drives the other.* (Science and Technology B, 9-10)

BIL: Recommended

EDU:	**12**	**AD**	**ApT**
	I	P	R

Competency 2.4: Explain how planning and budgeting are used to accomplish organizational goals and objectives.

Descriptors:

2.4.1 Explain how work plans and budgets are used to allocate people and resources.
2.4.2 Identify reports used to track performance and resources and explain how they are used.
2.4.3 Explain how plans and budgets are revised to meet goals and objectives.
2.4.4 Explain the impact of long term goals and planning on organization performance.
2.4.5 Identify and describe the most critical performance problems that manufacturing businesses typically face.
2.4.6 Describe how improvements are identified and modifications are implemented.

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)
- *Evaluate the usefulness and credibility of data and sources.* (Research B, 8-10)

Correlated Mathematics Academic Content Benchmarks

- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)
- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10*)*
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	I	P	R

Competency 2.5: **Explain material control and product inventories necessary to meet customer and business requirements.**

Descriptors:

2.5.1 Analyze the relationship of quality control to supply of materials.
2.5.2 Identify inventory control systems used in manufacturing (e.g., just-in-time).
2.5.3 Analyze the impact of inventory control systems on productivity and profit/loss.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Evaluate the usefulness and credibility of data and sources.* (Research B, 8-10)
- *Organize information from various resources and select appropriate sources to support central ideas, concepts and themes.* (Research C, 8-10)

Correlated Mathematics Academic Content Benchmarks

- *Translate information from one representation (words, table, graph or equation) to another representation of a relation or function.* (Patterns, Functions and Algebra C, 8-10)
- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis.* (Data Analysis and Probability E, 8-10)
- *Connect statistical techniques to applications in workplace and consumer situations.* (Data Analysis and Probability D, 11-12)
- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	I	P	R

Competency 2.6: **Benchmark financial and market performance against competitors.**

Descriptors:

2.6.1 Explain how financial performance is measured.
2.6.2 Explain how market performance is gauged.
2.6.3 Describe how service and internal operations performance is determined.
2.6.4 Explain how compliance and performance related to health, safety, environment, quality and delivery are evaluated.
2.6.5 Benchmark performances against competitors and the general industry.

Correlated Mathematics Academic Content Benchmarks

- *Translate information from one representation (words, table, graph or equation) to another representation of a relation or function.* (Patterns, Functions and Algebra C, 8-10)
- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)
- *Analyze and compare functions and their graphs using attributes, such as rates of change, intercepts and zeros.* (Patterns, Functions and Algebra E, 8-10)
- *Find, use and interpret measures of center and spread, such as mean and quartiles, and use those measures to compare and draw conclusions about sets of data.* (Data Analysis and Probability D, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)
- *Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability.* (Data Analysis and Probability B, 11-12)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	I	P	R

Competency 2.7: **Explain how changes outside manufacturing impact the manufacturing process.**

Descriptors:

2.7.1 Explain the impact of economic, social and technology changes.
2.7.2 Discuss the positive and negative impact of governmental regulation.
2.7.3 Relate the impact of international events to manufacturing.

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data Analysis and Probability A, 8-10)
- *Find, use and interpret measures of center and spread, such as mean and quartiles, and use those measures to compare and draw conclusions about sets of data.* (Data Analysis and Probability D, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)
- *Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability.* (Data Analysis and Probability B, 11-12)
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

Correlated Science Academic Content Benchmarks

- *Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)
- *Explain how societal issues and considerations affect the progress of science and technology.* (Scientific Ways of Knowing C, 11-12)

BIL: **Recommended**

EDU:	12	AD	ApT
	I	I	R

Competency 2.8: **Explain the role of risk management in reducing risks and improving performance in manufacturing businesses.**

Descriptors:

2.8.1 Explain the objectives of risk management programs.
2.8.2 Describe the major types of loss exposure for manufacturing businesses.
2.8.3 Summarize the approaches for managing organizational risks.

Correlated Mathematics Academic Content Benchmarks

- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

BIL: **Recommended**

EDU:	12	AD	ApT
	I	I	I

Competency 2.9: **Explain the roles and functions of government in regulating and supporting manufacturing business.**

Descriptors:

2.9.1 Describe the governmental roles in regulating domestic operations.
2.9.2 Discuss the governmental roles in regulating international operations.
2.9.3 Examine the governmental roles in managing the infrastructure of manufacturing businesses.
2.9.4 Explain the governmental roles in health, safety, and environment management.

BIL: **Recommended**

EDU:	12	AD	ApT
	I	I	I

Competency 2.10: **Explain how manufacturing businesses manage customer relationships.**

Descriptors:

2.10.1 Conduct in-depth investigation to identify internal and external customer needs.
2.10.2 Maintain a liaison with customer contacts.
2.10.3 Maintain customer satisfaction and address customer problems and complaints efficiently.
2.10.4 Communicate with internal and/or external customers to ensure production meets customer requirements.

Correlated English Language Arts Academic Content Benchmarks

- *Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted.* (Research A, 11-12)
- *Use a variety of strategies to enhance listening comprehension.* (Communication: Oral and Visual A, 8-10; Communication: Oral and Visual A, 11-12)
- *Give informational presentations that contain a clear perspective; present ideas from multiple sources in logical sequence; and include a consistent organizational structure.* (Communication: Oral and Visual E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis.* (Data Analysis and Probability E, 8-10)
- *Connect statistical techniques to applications in workplace and consumer situations.* (Data Analysis and Probability D, 11-12)
- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

BIL: Recommended

	12	AD	ApT
EDU:	**I**	I	R

Competency 2.11: Develop a management plan for business.
Descriptors:

2.11.1 Describe strategies to achieve company goals and objectives.
2.11.2 Design an organizational chart with job and activity descriptions.
2.11.3 Identify market segments and perspective clients.
2.11.4 Prepare a business development plan.

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)
- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia.* (Research E, 8-10; Research E, 11-12)
- *Prepare writing for publication that follows an appropriate format and uses a variety of techniques to enhance the final product.* (Writing Processes F, 11-12)
- *Produce informational essays or reports that establish a clear and distinctive perspective on the subject, include relevant perspectives, take into account the validity and reliability of sources and provide a clear sense of closure.* (Writing Applications D, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Design an experiment to test a theoretical probability, and record and explain results.* (Data Analysis and Probability I, 8-10)

- *Make predictions based on theoretical probabilities and experimental results.* (Data Analysis and Probability K, 8-10)

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	P

Competency 2.12: Identify basic procedures in the accounting cycle.

Descriptors:

2.12.1 Describe the basic application of internal and external accounting.
2.12.2 Describe the essential nature of profitability and value.
2.12.3 Describe job costing with direct and indirect costs.
2.12.4 Explain basic economic concepts (e.g., supply, demand, price, cost, profit, value, cash flow).

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)
- *Translate information from one representation (words, table, graph or equation) to another representation of a relation or function.* (Patterns, Functions and Algebra C, 8-10)
- *Analyze and compare functions and their graphs using attributes, such as rates of change, intercepts and zeros.* (Patterns, Functions and Algebra E, 8-10)

Unit 3: Communications

(Industry-Driven Authentic Assessment, See Appendix)

BIL: **Essential**

	12	AD	ApT
EDU:	**P**	R	R

Competency 3.1: Apply active listening skills to obtain and clarify information provided in oral communications.

Descriptors:

3.1.1 Identify and apply active listening techniques one -on -one and in team or group meetings.
3.1.2 Paraphrase and repeat information to confirm understanding.
3.1.3 Record and summarize information in written notes.
3.1.4 Ask questions to seek or confirm understanding.

Correlated English Language Arts Academic Content Benchmarks

- *Use a variety of strategies to enhance listening comprehension.* (Communication: Oral and Visual A, 8-10; Communication: Oral and Visual A, 11-12)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication: Oral and Visual C, 11-12)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	P	R	R

Competency 3.2: Listen and speak effectively to contribute to group discussions and meetings.

Descriptors:

3.2.1 Conduct meetings in a timely, organized, and professional manner.
3.2.2 Clarify the purpose and goals of a discussion or meeting.
3.2.2 Demonstrate respect for diverse cultures.
3.2.3 Give and receive feedback appropriately.
3.2.3 Stay on subject and task.
3.2.4 Summarize the results of the meeting, including agreements and disagreements.
3.2.5 Speak succinctly and clearly to convey information.
3.2.6 Utilize manufacturing terminology.
3.2.7 Discuss slang and jargon related to the different trades.

Correlated English Language Arts Academic Content Benchmarks

- *Use a variety of strategies to enhance listening comprehension.* (Communication: Oral and Visual A, 8-10; Communication: Oral and Visual A, 11-12)
- *Demonstrate an understanding of effective speaking strategies by selecting appropriate language and adjusting presentation techniques.* (Communication: Oral and Visual D, 8-10)
- *Give informational presentations that present ideas in a logical sequence, include relevant facts and details from multiple sources and use a consistent organizational structure.* (Communication: Oral and Visual E, 8-10)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication: Oral and Visual C, 11-12)
- *Apply editing strategies to eliminate slang and improve conventions.* (Writing Processes D, 11-12)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	P	R	R

Competency 3.3: Deliver formal and informal presentations that demonstrate organization and delivery skill.

Descriptors:

3.3.1 Demonstrate appropriate usage of grammar, diction and sentence structure.
3.3.2 Communicate main ideas and supporting facts to achieve the purpose of a presentation.
3.3.3 Use appropriate technology to enhance the clarity and persuasiveness.
3.3.4 Use proper organization and structure to achieve coherence.
3.3.5 Use technical terms, references, and quoted material properly.
3.3.6 Engage an audience using appropriate vocal variety and gestures.

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate an understanding of effective speaking strategies by selecting appropriate language and adjusting presentation techniques.* (Communication: Oral and Visual D, 8-10)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication: Oral and Visual C, 11-12)
- *Give informational presentations that contain a clear perspective; present ideas from multiple sources in logical sequence; and include a consistent organizational structure.* (Communication: Oral and Visual E, 11-12)
- *Provide persuasive presentations that use varied speaking techniques and strategies and include a clear controlling idea or thesis.* (Communication: Oral and Visual F, 8-10)
- *Give presentations using a variety of delivery methods, visual displays and technology.* (Communication: Oral and Visual G, 8-10; Communication: Oral and Visual F 11-12)

Correlated Science Academic Content Benchmarks

- *Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.* (Scientific Inquiry A, 9-10)

BIL: **Essential**

	12	AD	ApT
EDU:	**P**	R	R

Competency 3.4: **Write and utilize coherent and focused technical communications that support a defined perspective.**

Descriptors:

3.4.1 Use various note-taking techniques to summarize main ideas.
3.4.2 Structure ideas and arguments in an organized manner and that are supported by relevant documentation and/or examples.
3.4.3 Write messages using language that is appropriate for the intended audience and purpose.
3.4.4 Use correct spelling, grammar, capitalization and punctuation.
3.4.5 Identify positions from relevant research and resources.
3.4.6 Calculate and interpret descriptive statistics to communicate and support predictions and conclusions.
3.4.7 Utilize tables, charts and graphs to clarify textual explanations and support arguments.
3.4.8 Demonstrate neat and legible handwriting.

Correlated English Language Arts Academic Content Benchmarks

- *Formulate writing ideas and identify a topic appropriate to the purpose and audience.* (Writing Processes A, 8-10; Writing Processes A, 11-12)
- *Select and use an appropriate organizational structure to refine and develop ideas for writing.* (Writing Processes B, 11-12)
- *Prepare writing for publication that is legible, follows an appropriate format and uses techniques such as electronic resources and graphics.* (Writing Processes F, 8-10)
- *Prepare writing for publication that follows an appropriate format and uses techniques to enhance the final product.* (Writing Processes F, 11-12)
- *Edit to improve sentence fluency, grammar and usage*. (Writing Processes D, 8-10)

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)
- *Use correct spelling conventions.* (Writing Conventions A, 8-10; Writing Conventions A, 11-12)
- *Use correct punctuation and capitalization.* (Writing Conventions B, 8-10; Writing Conventions B, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data Analysis and Probability A, 8-10)
- *Find, use and interpret measures of center and spread, such as mean and quartiles, and use those measures to compare and draw conclusions about sets of data.* (Data Analysis and Probability D, 8-10)
- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)
- *Use descriptive statistics to analyze and summarize data, including measures of center, dispersion, correlation and variability.* (Data Analysis and Probability B, 11-12)
- *Write clearly and coherently about mathematical thinking and ideas.* (Mathematical Processes G, 8-10)
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

Correlated Science Academic Content Benchmarks

- *Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.* (Scientific Inquiry A, 9-10)
- *Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.* (Scientific Inquiry A, 11-12)

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	P

Competency 3.5: ***Employ information technology applications.***

Descriptors:

3.5.1 Identify organizational policies and ethics regarding the use of communications tools.
3.5.2 Use personal information management (PIM) productivity applications (e.g., schedules, contacts, memos).
3.5.3 Communicate using electronic equipment (e.g., email, fax, phone).
3.5.4 Use Internet applications.
3.5.5 Use writing and publishing applications.
3.5.6 Prepare reports and other business communications integrating graphics and other non-text elements.
3.5.7 Demonstrate presentation applications.

3.5.8 Use spreadsheets and database applications.
3.5.9 Employ collaborative and groupware applications.
3.5.10 Examine computer-driven equipment and machines and access support as needed.
3.5.11 Explain the meaning of new technical terms, vocabulary and concepts.
3.5.12 Summarize the overall meaning of a text.
3.5.13 Write specific steps for applying information learned to new tasks or jobs.
3.5.14 Share information from a text with others, and show how it can be applied.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)
- *Give presentations using a variety of delivery methods, visual displays and technology.* (Communication: Oral and Visual G, 8-10; Communication: Oral and Visual F, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data Analysis and Probability A, 8-10)
- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)
- *Formulate a problem or mathematical model in response to a specific need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution.* (Mathematical Processes A, 8-10)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)
- *Construct algorithms for multi-step and non-routine problems.* (Mathematical Processes A, 11-12)

BIL: Essential

	12	AD	ApT
EDU:	**I**	P	R

Competency 3.6: Use written documents to direct the work.
Descriptors:
3.6.1 Identify types of reports (e.g., quality assurance, shift turnover, schedules, preventive maintenance).
3.6.2 Generate work orders, including change order requests.
3.6.3 Calculate job cost and prepare billing documents.
3.6.4 Complete reports in accordance with established standards.
3.6.5 Apply concepts of tolerances and equivalency to specifications.
3.6.6 Identify the components of contract documents.

3.6.7 File reports with appropriate personnel.
3.6.8 Distribute written information from various sources to co-workers and clients.

Correlated English Language Arts Academic Content Benchmarks

- *Apply editing strategies to eliminate slang and improve conventions.* (Writing Processes D, 11-12)
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)
- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 8-10)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: **Essential**

	12	AD	ApT
EDU:	**P**	R	R

Competency 3.7: **Explain the fundamentals of manufacturing drawings, schematics, specifications and diagrams.**

Descriptors:
3.7.1 Recognize, identify and interpret specifications.
3.7.2 Interpret dimensions, symbols, types of lines, views and scales.
3.7.3 Make spatial interpretations of various three-dimensional forms from two-dimensional drawings.
3.7.4 Describe tolerances associated with dimensions.
3.7.5 Apply algebraic procedures and geometric concepts to reading construction documents.
3.7.6 Work within established industry tolerance parameters as defined by manufacturing documents.
3.7.7 Coordinate information between trades and professions.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Estimate and compute areas and volume in increasingly complex problem situations.* (Measurement C, 11-12)
- *Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines and parallel lines.* (Geometry and Spatial Sense C, 8-10)
- *Use coordinate geometry to represent and examine the properties of geometric figures.* (Geometry and Spatial Sense D, 8-10)

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	R

Competency 3.8: Research and respond to customer needs.
Descriptors:

3.8.1 Recognize the importance of all customers to business.
3.8.2 Describe the relationship between meeting customer needs and profitability.
3.8.3 Interact with customers and venders in a professional manner.
3.8.4 Demonstrate professional phone etiquette when dealing with customers, vendors and the general public.
3.8.5 Follow through on commitments made to customers and vendors in a timely manner.

Correlated English Language Arts Academic Content Benchmarks

- *Use a variety of strategies to enhance listening comprehension.* (Communication: Oral and Visual A, 8-10; Communication: Oral and Visual A, 11-12)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication: Oral and Visual C, 11-12)

Unit 4: Problem Solving and Critical Thinking

BIL: Essential

critical

	12	AD	ApT
EDU:	**I**	P	P

Competency 4.1: Employ thinking and problem-solving skills independently or in teams to formulate solutions to problems.
Descriptors:

4.1.1 Define problem-solving methods accepted in the manufacturing industry.
4.1.2 State the problem completely and precisely.
4.1.3 Assemble and examine pertinent information.
4.1.4 Brainstorm potential solutions.
4.1.5 Identify constraints and parameters to solutions as they relate to budgets, scope or schedules.
4.1.6 Compare and contrast consequences and discuss underlying assumptions.
4.1.7 Identify the best solution based on risks, costs, ethics, laws, benefits, conflicting concerns and points of view.
4.1.8 Apply the best solution to the problem.
4.1.9 Evaluate the solution.

Correlated English Language Arts Academic Content Benchmarks

- *Formulate open-ended research questions suitable for investigation and adjust questions as necessary while research is conducted.* (Research A, 8-10)
- *Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted.* (Research A, 11-12)
- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)
- *Organize information from various resources and select appropriate sources to support central ideas, concepts and themes.* (Research C, 8-10)

- *Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)
- *Communicate findings, reporting on the substance and processes orally, visually and in writing or through multimedia.* (Research E, 8-10; Research E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)
- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Formulate a problem or mathematical model in response to a specific need or situation, determine information required to solve the problem, choose method for obtaining this information, and set limits for acceptable solution.* (Mathematical Processes A, 8-10)
- *Use precise mathematical language and notations to represent problem situations and mathematical ideas.* (Mathematical Processes F, 8-10)
- *Present complete and convincing arguments and justifications, using inductive and deductive reasoning, adapted to be effective for various audiences.* (Mathematical Processes F, 11-12)
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretation of solution within the model, and validation to original problem situation.* (Mathematical Processes J, 11-12)

Correlated Science Academic Content Benchmarks

- *Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	P

Competency 4.2: **Apply problem solving and critical thinking techniques to the conflict between available resources, requirements of the project and manufacturing timelines.**

Descriptors:

4.2.1 Identify alternative solutions for a specific resources and materials problem.
4.2.2 Calculate the potential waste of resources and materials.
4.2.3 Examine the feasibility of each alternative suggestion.
4.2.4 Implement an appropriate alternative.
4.2.5 Use available resources and materials efficiently to complete a project.
4.2.6 Discuss strategies to avoid the problem in the future.

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions.* (Measurement F, 8-10)
- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Locate and interpret mathematical information accurately, and communicate ideas, processes and solutions in a complete and easily understood manner.* (Mathematical Processes H, 8-10)
- *Present complete and convincing arguments and justifications, using inductive and deductive reasoning, adapted to be effective for various audiences.* (Mathematical Processes F, 11-12)
- *Apply mathematical modeling to workplace and consumer situations, including problem formulation, identification of a mathematical model, interpretation of solution within the model, and validation to original problem situation.* (Mathematical Processes J, 11-12)

Correlated Science Academic Content Benchmarks

- *Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	P

Competency 4.3: Combine critical thinking and team building skills to solve problems.
Descriptors:

4.3.1 Work with others to define problems.
4.3.2 Share ideas, facts, information and/or data with others.
4.3.3 State personal positions clearly, and respect conflicting positions.
4.3.4 Accept and support group decisions even when different from a personal solution within bounds of ethical, safety or legal concerns.

Correlated English Language Arts Academic Content Benchmarks

- *Communicate findings, reporting on the substance and processes orally, visually and in writing, or through multimedia.* (Research E, 8-10; Research E, 11-12)
- *Use a variety of strategies to enhance listening comprehension.* (Communication: Oral and Visual A, 8-10; Communication: Oral and Visual A, 11-12)
- *Select and use effective speaking strategies for a variety of audiences, situations, and purposes.* (Communication: Oral and Visual C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	P

Competency 4.4: **Evaluate and adjust plans and schedules to respond to unexpected events and conditions.**

Descriptors:

4.4.1 Identify potential events and conditions that could disrupt the completion of a job.
4.4.2 Incorporate potential job disruptions into planning time lines.
4.4.3 Solve situational problems involved with unexpected events and conditions.
4.4.4 Identify and assess critical situations and implement appropriate response.
4.4.5 Adjust plans and schedules to reflect an unexpected change.
4.4.6 Provide a project update to track change.

Correlated English Language Arts Academic Content Benchmarks

- *Formulate open-ended research questions suitable for investigation and adjust questions as necessary while research is conducted.* (Research A, 8-10)
- *Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted.* (Research A, 11-12)
- *Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)
- *Write and solve real-world, multi-step problems involving money, elapsed time and temperature, and verify reasonableness of solutions. (Measurement F, 8-10)*
- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Communicate mathematical ideas orally and in writing with a clear purpose and appropriate for a specific audience.* (Mathematical Processes I, 11-12)

Correlated Science Academic Content Benchmarks

- *Explain the ways in which the processes of technological design respond to the needs of society.* (Science and Technology A, 9-10)

Unit 5: Leadership and Teamwork

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	R

Competency 5.1: Summarize the interpersonal skills that contribute to positive leadership and teamwork.

Descriptors:

5.1.1 Identify and explain basic interpersonal skills most closely associated with a positive work environment (e.g., empathy, listening, respect, unconditional positive regard).

5.1.2 Discuss the importance of relating to the culture of an organization.

5.1.3 Identify the variety of cultural diversity in the workplace (e.g., race, religion, nationality, gender).

5.1.4 Discuss cultural diversity issues related to international business.

BIL: Essential

	12	AD	ApT
EDU:	**P**	R	R

Competency 5.2: Demonstrate the ability to work on a team and recognize the importance of teamwork and its impact on business in a manufacturing environment.

Descriptors:

5.2.1 Define teamwork and team goals and objectives.

5.2.2 Identify types of team (e.g., cross-functional, cross-trained).

5.2.3 Describe the role of effective teams in high-performance workplaces.

5.2.4 Examine unique issues associated with working on teams.

5.2.5 Apply team problem-solving and conflict-resolution practices.

5.2.6 Explain the roles and responsibilities of the individual as part of a team.

5.2.7 Identify attitudes and behaviors that promote positive interaction between members of the work team (e.g., punctuality, attendance, preparedness).

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication: Oral and Visual C, 11-12)

BIL: Essential

	12	AD	ApT
EDU:	**P**	R	R

Competency 5.3: Perform responsibly as a team member.

Descriptors:

5.3.1 Organize and schedule dependent team assignments.

5.3.2 Demonstrate an organized team approach to accomplishing tasks to meet a deadline.

5.3.3 Assist other members of the work team.

5.3.4 Discuss typical safety situations encountered where teamwork is essential.

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

BIL: Essential

EDU:	12	AD	ApT
	I	P	R

Competency 5.4: Use motivational techniques to enhance performance in others.

Descriptors:

5.4.1 Describe the induction process new employees experience when they enter a new work group.
5.4.2 Discuss communication barriers new employees may encounter.
5.4.3 Use reward and incentive systems.
5.4.4 Coach associates to expand their role within the manufacturing process.
5.4.5 Use coaching skills to inspire others to achieve.

Correlated English Language Arts Academic Content Benchmarks

- *Use a variety of strategies to enhance listening comprehension.* (Communication: Oral and Visual A, 8-10; Communication: Oral and Visual A, 11-12)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication: Oral and Visual C, 11-12)

BIL: Essential

EDU:	12	AD	ApT
	P	R	R

Competency 5.5: Describe the basic origins of conflict and the needs that motivate behavior.

Descriptors:

5.5.1 Identify the basic psychological needs that motivate behavior (e.g., belonging, power, freedom).
5.5.2 Discuss the role that different values play in generating conflict.
5.5.3 Identify how the effects of substance abuse, mental health and disabilities impact conflict.

BIL: Essential

EDU:	12	AD	ApT
	P	R	R

Competency 5.6: Examine the different responses to conflict as they relate to results.

Descriptors:

5.6.1 Describe the soft response approach (avoidance, compromise and accommodation) and the typical reasons for using that approach.
5.6.2 Describe the hard response approach (force, threats, aggression and anger) and the typical reasons for using that approach.
5.6.3 Describe the principled response approach (good communication skills, problem solving skills and the ability to see the problem from more than one perspective) and the typical reasons for using that approach.

BIL: Essential

	12	AD	ApT
EDU:	**P**	R	R

Competency 5.7: Resolve conflicts to maintain a smooth workflow.
Descriptors:

5.7.1 Use conflict resolution skills.
5.7.2 Work collaboratively and cooperatively.
5.7.3 Give and receive criticism in a diplomatic and constructive manner.
5.7.4 Use diplomatic and constructive statements and responses.
5.7.5 Manage stress and control emotions.
5.7.6 Convey honesty and integrity when providing feedback to associates.

Correlated English Language Arts Academic Content Benchmarks

- *Use a variety of strategies to enhance listening comprehension*. (Communication: Oral and Visual A, 8-10; Communication: Oral and Visual A, 11)
- *Select and use effective speaking strategies for a variety of audiences, situations and purposes.* (Communication: Oral and Visual C, 11-12)

Unit 6: Legal and Ethical Aspects

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

	12	AD	ApT
EDU:	**I**	P	R

Competency 6.1: Differentiate between legal and ethical issues.
Descriptors:

6.1.1 Identify "legal" and "ethical" issues.
6.1.2 Translate legal and ethical issues to the manufacturing industry.
6.1.3 Define and distinguish between company and departmental polices.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary*. (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Formulate open-ended research questions suitable for investigation and adjust questions as necessary while research is conducted.* (Research A, 8-10)
- *Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted.* (Research A, 11-12)

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	P

Competency 6.2: **Complete work-related duties within an ethical framework.**

Descriptors:

6.2.1 Identify codes of ethics within the professions.

6.2.2 Develop an individual ethical framework.

6.2.3 Demonstrate ethical behavior when interacting with colleagues both internal and external to the profession.

6.2.4 Describe the ethical impact of positive cultural sensitivity in a manufacturing organization.

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)
- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

BIL: **Essential**

	12	AD	ApT
EDU:	P	R	R

Competency 6.3: **Assess the implications of ethical and unethical behavior.**

Descriptors:

6.3.1 Compare and contrast personal, professional and organizational ethics.

6.3.2 Demonstrate respect for the property of customers, other professions and coworkers.

6.3.3 Resolve issues relating to any potential conflicts of interest between personal and organizational ethics.

6.3.4 Identify strategies for responding to the unethical actions of individuals and organizations.

6.3.5 Identify the ramifications of unethical actions.

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	R

Competency 6.4: **Perform duties according to laws, regulations, contract provisions and policies.**

Descriptors:

6.4.1 Describe legal responsibilities, limitations and implications of actions.

6.4.2 Comply with legal responsibilities specified by state practice act(s) and other pertinent legislation.

6.4.3 Compare and contrast the roles of various regulatory agencies (e.g., content of laws and regulation of jurisdictions).

6.4.4 Identify the types of contracts and describe their roles in the manufacturing industry.

6.4.5 Illustrate how work activities relate to health and safety issues.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

BIL: Essential

	12	AD	ApT
EDU:	**I**	P	P

Competency 6.5: Comply with applicable government regulations and codes.
Descriptors:

6.5.1 Identify governmental regulations and codes.
6.5.2 Describe mandated standards for workplace safety, harassment, labor and employment laws.
6.5.3 Identify personal and organizational ramifications for failure to comply with government laws and regulations.
6.5.4 Describe the interrelationships between local and national codes.
6.5.5 Identify legal responsibilities specified by state practice act(s) and other pertinent legislation (e.g., substance abuses, harassment, discrimination).
6.5.6 Identify legal responsibilities specified by state practice act(s), other pertinent legislation and regulatory agencies as it relates to union and/or non-union practices.
6.5.7 Apply regulations and codes according to guidelines.
6.5.8 Complete job inspections and adhere to all regulations and codes.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Apply reading comprehension strategies to understand grade-appropriate texts.* (Reading Process A, 8-10; Reading Process A, 11-12)
- *Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)
- *Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data Analysis and Probability A, 8-10)

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	R

Competency 6.6: **Explain employee and employer liability.**

Descriptors:

6.6.1 Define liability and negligence.
6.6.2 Discuss protections against liability.
6.6.3 Explain the role of the Bureau of Workers' Compensation in workplace injuries.
6.6.4 Discuss the concept of transferring risk.
6.6.5 Describe the "multi-employer" responsibility under the Occupational Safety and Health Act (OSHA) and identify the types of citations.

Correlated English Language Arts Academic Content Benchmarks

- *Use context clues and text structures to determine the meaning of new vocabulary.* (Acquisition of Vocabulary A, 8-10)
- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

Unit 7: Safety

(Industry-Driven Authentic Assessment, See Appendix)

BIL: **Essential**

	12	AD	ApT
EDU:	**P**	R	R

Competency 7.1: **Maintain general safety in accordance with government regulations, health standards and company policy**

Descriptors:

7.1.1 Wear personal protective equipment (PPE) as appropriate (e.g., dust mask, hearing protection, respirators, eye protection).
7.1.2 Check and correct potential hazards (e.g., hair, jewelry, clothing).
7.1.3 Maintain personal protective equipment (i.e., inspect, clean and replace).
7.1.4 Follow established procedures for the use of safety apparatus and equipment, including fall protection.
7.1.5 Conduct routine building safety inspections.
7.1.6 Check power sources for potential hazards and confirm proper grounding.
7.1.7 Shut down power equipment in dangerous situations using disconnect switches and established lock-out/tag-out procedures.
7.1.8 Identify the location of emergency flush showers, eye wash fountains, fire alarms and exits.
7.1.9 Maintain work areas in accordance with standards for cleanliness and safety.
7.1.10 Interpret personal safety rights according to the shop's right-to-know plan.
7.1.11 Describe how to operate fire extinguishers and identify classes of fires.

7.1.12 Inspect air and exhaust systems, including intake filters, fans, and other mechanical components.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data Analysis and Probability A, 8-10)

Correlated Science Academic Content Benchmarks

- *Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations*. (Scientific Inquiry A, 9-10)
- *Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data*. (Scientific Inquiry A, 11-12)

BIL: Essential

	12	AD	ApT
EDU:	**P**	R	R

Competency 7.2: Evaluate the ergonomic factors associated with the manufacturing industry.
Descriptors:

7.2.1 Define ergonomics.
7.2.2 Describe ergonomic factors in the workplace.
7.2.3 Identify work associated with repetitive motion and with lifting or moving heavy objects.
7.2.4 Demonstrate appropriate body mechanics in lifting and moving heavy objects.
7.2.5 Describe the ergonomic importance of properly operating various types of tools and equipment.

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots and affixes to determine the meanings of complex words and subject area vocabulary.* (Acquisition of Vocabulary E, 8-10)

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Describe sampling methods and analyze the effects of method chosen on how well the resulting sample represents the population.* (Data Analysis and Probability G, 8-10)
- *Design an experiment to test a theoretical probability, and record and explain results.* (Data Analysis and Probability I, 8-10)
- *Design and perform a statistical experiment, simulation or study; collect and interpret data; and use descriptive statistics to communicate and support predictions and conclusions.* (Data Analysis and Probability C, 11-12)

BIL: **Essential**

EDU:	12	AD	ApT
	I	P	P

Competency 7.3: **Identify state, federal and local worker safety, health and environmental regulations.**

Descriptors:

7.3.1 Examine the Occupational Safety and Health Administration (OSHA) regulations.
7.3.2 Examine the Bureau of Workers' Compensation (BWC) regulations.
7.3.3 Explain workers' compensation cost as it relates to manufacturing.
7.3.4 Describe the purpose of National Institute for Occupational Safety and Health (NIOSH).
7.3.5 Process safety documentation.
7.3.6 Discuss applicable international regulations that impact manufacturing operations.
7.3.7 Discuss the Environmental Protection Agency (EPA) regulations.
7.3.8 Describe the industry-specific governmental regulatory agencies.
7.3.9 Interpret personal safety rights, according to employees' right-to-know plans.

Correlated English Language Arts Academic Content Benchmarks

- *Use context clues and text structures to determine the meaning of new vocabulary.* (Acquisition of Vocabulary A, 8-10)
- *Apply reading comprehension strategies to understand grade-appropriate texts.* (Reading Process A, 8-10; Reading Process A, 11-12)
- *Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)

Correlated Science Academic Content Benchmarks

- *Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations*. (Scientific Inquiry A, 9-10)
- *Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data*. (Scientific Inquiry A, 11-12)

BIL: Essential

EDU:	12	AD	ApT
	P	R	R

Competency 7.4: Demonstrate practices that contribute to an accident-free environment.
Descriptors:

7.4.1 Identify unsafe operations of a process.
7.4.2 Establish safety training meetings with relevant topics.
7.4.3 Explain the concept of "engineering out" as a personal protection strategy.
7.4.8 Conduct and participate in accident and/or incident investigations.
7.4.9 Perform a job safety analysis (JSA).
7.4.10 Inform and correct unsafe activities committed by coworkers.
7.4.11 Examine access and egress procedures.
7.4.12 Explain the concepts of lock-out/tag-out and block-out.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

B**IL: Essential**

EDU:	12	AD	ApT
	P	R	R

Competency 7.5: Explain emergency response plans in a variety of industrial settings.
Descriptors:

7.5.1 Describe different types of emergency response plans.
7.5.2 Explain procedures to be followed in the event of an emergency response.
7.5.3 Describe the personal protective equipment (PPE) and response equipment and materials needed for emergency response.
7.5.4 Explain the importance of material safety data sheets (MSDS) in an emergency response.
7.5.5 Practice universal precautions to protect against infection.

Correlated English Language Arts Academic Content Benchmarks

- *Apply reading comprehension strategies to understand grade-appropriate texts.* (Reading Process A, 8-10; Reading Process A, 11-12)

BIL: Recommended

EDU:	12	AD	ApT
	I	I	I

Competency 7.6: Complete requirements for first aid and CPR certification.
Descriptors:

7.6.1 Complete first aid training and certification.
7.6.2 Complete cardiopulmonary resuscitation (CPR) training and certification.

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

BIL: **Essential**

	12	AD	ApT
EDU:	**P**	R	R

Competency 7.7: Complete and apply operations and safety training on all equipment.
Descriptors:

7.7.1 Complete orientation to all equipment before operating.
7.7.2 Review all important information regarding equipment safety.
7.7.3 Utilize the correct tools to do the job during training.
7.7.4 Conduct a post-training evaluation to assure that equipment is operated safely.
7.7.5 Document the quality and effectiveness of the training.
7.7.6 Fulfill safety and heath requirements for maintenance.
7.7.7 Monitor and operate equipment in compliance with both company and national regulations.

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)
- *Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)

Unit 8: Health and Environment

(Industry-Driven Authentic Assessment, See Appendix)

BIL: **Essential**

	12	AD	ApT
EDU:	P	R	R

Competency 8.1: Identify practices that contribute to a healthy environment.
Descriptors:

8.1.1 Discuss symptoms of exposure to health-threatening environments; e.g., temperature, chemicals, noise vibrations harshness (NVH), biological hazards.
8.1.2 Describe the effects of hazardous activities (e.g., welding).
8.1.3 Describe precautions required when using toxic or flammable materials (i.e., if ingested, contacted or inhaled).
8.1.3 Discuss the inspection of air and exhaust systems, including intake filters, fans and other mechanical components.
8.1.4 Describe the interactions of incompatible substances.

Correlated Science Academic Content Benchmarks

- *Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.* (Scientific Inquiry A, 9-10)
- *Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.* (Scientific Inquiry A, 11-12)

BIL: Recommended

	12	AD	ApT
EDU:	**I**	I	P

Competency 8.2: Explain the environmental aspects of worksites with contaminated waste.

Descriptors:

8.2.1 Describe procedures for disposing personal protective equipment.
8.2.2 Explain disposal procedures for contaminated manufacturing waste.

BIL: Essential

	12	AD	ApT
EDU:	P	R	R

Competency 8.3: Handle hazardous materials in accordance with government regulations and health standards.

Descriptors:

8.3.1 Identify types of hazardous materials.
8.3.2 Interpret container label precautions.
8.3.3 Interpret material safety data sheets (MSDS) and use materials accordingly.
8.3.4 Identify hazardous storage procedures in compliance with government regulations.
8.3.5 Dispose of hazardous materials in accordance with government regulations.
8.3.6 Examine a hazardous materials safety plan.

Correlated English Language Arts Academic Content Benchmarks

- *Apply reading comprehension strategies to understand grade-appropriate texts.* (Reading Process A, 8-10; Reading Process A, 11-12)

Correlated Science Academic Content Benchmarks

- *Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.* (Scientific Inquiry A, 9-10)
- *Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.* (Scientific Inquiry A, 11-12)

BIL: **Essential**

EDU:	12	AD	ApT
	I	P	P

Competency 8.4: **Identify the relationship between production processes and human health and environmental problems.**

Descriptors:

8.4.1 Describe the environmental and business impacts of different materials, production processes and product life cycles.

8.4.2 Describe environmental and health data to interpret trends.

8.4.3 Identify the role of design in closing a product's life cycle.

8.4.4 Identify and illustrate how internal and external forces or drivers can motivate companies to convert to sustainable manufacturing systems.

Correlated Mathematics Academic Content Benchmarks

- *Construct convincing arguments based on analysis of data and interpretation of graphs.* (Data Analysis and Probability F, 8-10)
- *Connect statistical techniques to applications in workplace and consumer situations.* (Data Analysis and Probability D, 11-12)

Correlated Science Academic Content Benchmarks

- *Describe the finite nature of Earth's resources and those human activities that can conserve or deplete Earth's resources.* (Earth and Space Sciences D, 9-10)
- *Explain that humans are an integral part of the Earth's system and the choices humans make today impact natural systems in the future.* (Earth and Space Sciences C, 11-12)
- *Describe how human activities can impact the status of natural systems.* (Life Sciences G, 9-10)
- *Explain how human choices today will affect the quality and quantity of life on Earth.* (Life Sciences F, 11-12)

Unit 9: Tools and Equipment

(Industry-Driven Authentic Assessment, See Appendix)

BIL: **Essential**

EDU:	12	AD	ApT
	P	R	R

Competency 9.1: **Identify basic tools and equipment appropriate to manufacturing.**

Descriptors:

9.1.1 Identify the various types of tools and equipment applicable to a specified manufacturing application.

9.1.2 Describe the primary functions of various types of hand and power tools.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	P	R	R

Competency 9.2: ***Demonstrate appropriate use of basic hand tools to complete work functions.***

Descriptors:

9.2.1 Identify potential hazards and limitations related to the use of tools.
9.2.2 Demonstrate basic measuring tools.
9.2.3 Use tools in accordance with established procedures and safety standards.

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	P	R	R

Competency 9.3: **Operate power tools and stationary equipment.**

Descriptors:

9.3.1 Identify types of power tools and stationary equipment and their functions in manufacturing.
9.3.2 Match appropriate power tools and stationary equipment for a given task.
9.3.3 Operate power tools and equipment in accordance with established procedures and safety standards.

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	P	R	R

Competency 9.4: **Maintain hand and power tools appropriate to manufacturing.**

Descriptors:

9.4.1 Conduct routine inspections of hand tools and power equipment.
9.4.2 Troubleshoot maintenance problems in accordance with established procedures.
9.4.3 Perform preventive maintenance in accordance with guidelines specified by the manufacturer and/or outside authorities with jurisdiction (e.g., OSHA).
9.4.4 Describe the certifications for operating specific tools.

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

BIL: **Essential**

	12	AD	ApT
EDU:	**P**	R	R

Competency 9.5: Use appropriate personal protective equipment (PPE).
Descriptors:

9.5.1 Identify the appropriate personal protective equipment (PPE) to wear with specific manufacturing tasks.

9.5.2 Discuss various conditions that workers encounter, and match appropriate personal protective equipment to each situation.

9.5.3 Demonstrate and practice correct fit, use of each type and care of personal protective equipment (PPE).

Unit 10: Manufacturing Technology Basics

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

	12	AD	ApT
EDU:	P	R	R

Competency 10.1: Evaluate products in relation to size, proportion and tolerances.
Descriptors:

10.1.1 Demonstrate a command of the International Standards of Units (SI or metric) system.

10.1.2 Demonstrate a command of the English measurement system.

10.1.3 Measure products using the SI and English systems.

10.1.4 Utilize appropriate measurement equipment and techniques.

10.1.5 Explain measurement in proportion to tolerances common to manufacturing (e.g., millionths, thousandths, 10 thousandths).

10.1.6 Differentiate broad versus close tolerances in relation to manufacturing and product cost.

Correlated Mathematics Academic Content Benchmarks

- *Use formulas to find surface area and volume for specified three-dimensional objects accurate to a specified level of precision.* (Measurement B, 8-10)
- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)
- *Explain differences among accuracy, precision and error, and describe how each of those can affect solutions in measurement situations.* (Measurement A, 11-12)
- *Estimate and compute areas and volume in increasingly complex problem situations.* (Measurement C, 11-12)

BIL: Essential

	12	AD	ApT
EDU:	P	R	R

Competency 10.2: Interpret drawings, prints and schematics
Descriptors:

10.2.1 Identify commonly used symbols and abbreviations.
10.2.2 Interpret orthographic projections, including first and third angle projections.
10.2.3 Describe tolerances and dimensioning.
10.2.4 Visualize objects from drawings.
10.2.5 Identify machine, hydraulic, pneumatic, instrument and electrical drawings, prints and schematics.

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12)
- *Analyze whether graphics supplement textual information and promote the author's purpose.* (Reading Applications: Informational, Technical and Persuasive Text C, 8-10)

Correlated Mathematics Academic Content Benchmarks

- *Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)

Correlated Science Academic Content Benchmarks

- *Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.* (Scientific Inquiry A, 9-10)

BIL: Essential

EDU:	**12**	**AD**	**ApT**
	I	P	R

Competency 10.3: Demonstrate basic drawing skills.
Descriptors:

10.3.1 Identify line styles and weights.
10.3.2 Examine and describe orthographic views.
10.3.3 Construct freehand sketches.
10.3.4 Interpret notes and apply dimensions.
10.3.5 Demonstrate line weights, types and uniformity techniques.
10.3.6 Perform basic geometric construction (e.g., line dividing, angles, tangents).
10.3.7 Lay out drawings using basic drawing equipment and scales.

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12)
- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Apply indirect measurement techniques, tools and formulas, as appropriate, to find perimeter, circumference and area of circles, triangles, quadrilaterals and composite shapes, and to find volume of prisms, cylinders, and pyramids.* (Measurement C, 8-10)
- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Recognize and apply angle relationships in situations involving intersecting lines, perpendicular lines and parallel lines.* (Geometry and Spatial Sense C, 8-10)
- *Use coordinate geometry to represent and examine the properties of geometric figures.* (Geometry and Spatial Sense D, 8-10)
- *Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology.* (Geometry and Spatial Sense E, 8-10)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	I	P	R

Competency 10.4: Describe basic electrical and electronic theory.
Descriptors:

10.4.1 Identify how electricity and electronics are used in manufacturing processes.
10.4.2 Discuss the scientific laws related to electricity.
10.4.3 Describe the uses of series, parallel and combination circuits.
10.4.4 Differentiate between alternating current (AC) and direct current (DC) terms and applications.
10.4.5 Discuss schematic drawings and blueprints.
10.4.6 Discuss power and control circuit installation.

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Solve and graph linear equations and inequalities.* (Patterns, Functions and Algebra F, 8-10)
- *Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)
- *Create, interpret and use graphical displays and statistical measures to describe data; e.g., box-and-whisker plots, histograms, scatterplots, measures of center and variability.* (Data Analysis and Probability A, 8-10)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)
- *Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

- *Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena.* (Physical Sciences A, 11-12)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	I	P	R

Competency 10.5: **Identify voltage, current, resistance, charge and load using electrical test equipment.**

Descriptors:

10.5.1 Comply with safety procedures established for the use of testing equipment.

10.5.2 Identify and use appropriate electrical testing equipment to test for voltage, current, resistance, charge and load.

Correlated Mathematics Academic Content Benchmarks

- *Compare, order and determine equivalent forms of real numbers.* (Number, Number Sense and Operations E, 8-10)
- *Model and solve problem situations involving direct and inverse variation.* (Patterns, Functions and Algebra I, 8-10)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance*. (Physical Sciences C, 9-10)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	I	P	R

Competency 10.6: **Describe basic hydraulic and pneumatic systems.**

Descriptors:

10.6.1 Describe how hydraulic and pneumatic systems are used in manufacturing processes.

10.6.2 Recognize basic hydraulic and pneumatic systems and components.

10.6.3 Recognize circuit diagrams (e.g., hydraulic, pneumatic).

10.6.4 Recognize connectors (e.g., hoses, fittings, tubes).

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12)
- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

BIL: Essential

EDU:	12	AD	ApT
	I	P	R

Competency 10.7: Describe fluid flow concepts.
Descriptors:

10.7.1 Describe how flow concepts are used in manufacturing processes.
10.7.2 Identify types of fluids (e.g., air, water, oil).
10.7.3 Identify properties of fluid flow (e.g., pressure, flow).
10.7.4 Discuss scientific principles to fluid flow (e.g., Pascal's law, Boyle's law, Bernoulli's equation).

Correlated Mathematics Academic Content Benchmarks

- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)
- *Estimate and compute areas and volume in increasingly complex problem situations.* (Measurement C, 11-12)

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

BIL: Essential

EDU:	12	AD	ApT
	I	P	P

Competency 10.8: Describe welding procedures for metals and plastics.
Descriptors:

10.8.1 Describe how welding procedures are used in manufacturing processes.
10.8.2 Identify basic welding joints.
10.8.3 Describe the welding procedures specified for a given job.
10.8.4 Identify various welding processes.
10.8.5 Interpret basic welding symbols and their components.
10.8.6 Identify the purpose of the welding fixtures for a given production process.

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12)
- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	I	P	P

Competency 10.9: Describe materials joining procedures.
Descriptors:

10.9.1 Describe how material joining procedures are used in manufacturing processes.
10.9.2 Identify compatibility of materials.
10.9.3 Identify types of bonds (e.g., chemical, thermal, mechanical).
10.9.4 Identify types of fasteners (e.g., nuts, bolts, rivets).
10.9.5 Identify grades of fasteners.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Analyze whether graphics supplement textual information and promote the author's purpose.* (Reading Applications: Informational, Technical and Persuasive Text C, 8-10)

Correlated Science Academic Content Benchmarks

- *Explain how atoms react with each other to form other substances and how molecules react with each other or other atoms to form even different substances.* (Physical Sciences B, 9-10)
- *Explain how variations in the arrangement and motion of atoms and molecules form the basis of a variety of biological, chemical and physical phenomena.* (Physical Sciences A, 11-12)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	I	P	P

Competency 10.10: Identify machining procedures for metals and plastics.
Descriptors:

10.10.1 Describe turning procedures used in manufacturing processes.
10.10.2 Discuss milling procedures used in manufacturing processes.
10.10.3 Describe computer numerical control (CNC) machining operations.
10.10.4 Discuss electrical discharge machines (EDM) operations and procedures (carbon and wire type).
10.10.5 Describe surface grinding procedures used in manufacturing processes.
10.10.6 Identify the process for calculating feeds and speeds.
10.10.7 Describe specialized processes (e.g., broaching, gear cutting, thread cutting).
10.10.8 Identify types of tooling; e.g., high-speed steel (HSS), carbide, ceramic.
10.10.9 Describe drilling procedures used in manufacturing processes.
10.10.10 Identify processes appropriate for specific materials (e.g., hardened, non-hardened, heat-treated).

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12)
- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: **Essential**

EDU:	**12**	**AD**	**ApT**
	P	R	R

Competency 10.11: Describe the application of basic mechanical physics.
Descriptors:

10.11.1 Identify how mechanical physics is used in manufacturing processes.
10.11.2 Differentiate between simple machines and their functions (e.g., pulleys and levers).
10.11.3 Analyze potential and kinetic energy.
10.11.4 Describe scientific laws associated with mechanical physics.
10.11.5 Identify variables that affect mechanical physics (e.g., temperature, vibrations, stresses, forces).

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12)
- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

Correlated Science Academic Content Benchmarks

- *Explain the movement of objects by applying Newton's three laws of motion*. (Physical Sciences D, 9-10)
- *Demonstrate that energy can be considered to be either kinetic (motion) or potential (stored*). (Physical Sciences E, 9-10)

- *Explain how energy may change form or be redistributed but the total quantity of energy is conserved.* (Physical Sciences F, 9-10)
- *Apply principles of forces and motion to mathematically analyze, describe and predict the net effects on objects or systems.* (Physical Sciences D, 11-12)

BIL: **Essential**

EDU:	12	AD	ApT
	I	P	R

Competency 10.12: Describe plastic processing and compounding.
Descriptors:

10.12.1 Describe how plastics processing and compounding are used in manufacturing processes.
10.12.2 Identify materials (e.g., thermoset, thermoplastic).
10.12.3 Identify processes (e.g., injection-molding, blow-molding, extrusion).
10.12.4 Describe applications and materials appropriate for specified processes.

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12)
- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

BIL: **Essential**

EDU:	12	AD	ApT
	I	P	P

Competency 10.13: Identify materials for type and quality.
Descriptors:

10.13.1 Describe needed information using bills of material on appropriate reference drawings.
10.13.2 Describe the classification and physical properties of ferrous and nonferrous metals.
10.13.3 Describe test methods (e.g., American Society for Testing and Materials [ASTM]).
10.13.4 Describe a variety of material tests (e.g., spark, magnetic, scratch, burn [plastic]).

Correlated English Language Arts Academic Content Benchmarks

- *Apply knowledge of roots, affixes and phrases to aid understanding of content area vocabulary.* (Acquisition of Vocabulary D, 11-12)
- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Apply reading comprehension strategies to understand grade-appropriate texts.* (Reading Process A, 8-10; Reading Process A, 11-12)

Correlated Science Academic Content Benchmarks

Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance. (Physical Sciences C, 9-10)

BIL: **Essential**

EDU:	12	AD	ApT
	I	P	P

Competency 10.14: Practice preventive and predictive maintenance in accordance with guidelines specified by manufacturers and/or outside authorities with jurisdiction.

Descriptors:

10.14.1 Maintain operating and maintenance records.
10.14.2 Access needed information from past maintenance records.
10.14.3 Follow preventive and predictive maintenance schedule.
10.14.4 Access needed information using preventive maintenance manuals.
10.14.5 Log preventive maintenance performed.

Correlated English Language Arts Academic Content Benchmarks

- *Use appropriate self-monitoring strategies for comprehension.* (Reading Process C, 8-10; Reading Process C, 11-12)
- *Synthesize the content from several sources on a single issue or written by a single author, clarifying ideas and connecting them to other sources and related topics.* (Reading Applications: Informational, Technical and Persuasive Text D, 11-12).
- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Use algebraic representations, such as tables, graphs, expressions, functions and inequalities, to model and solve problem situations.* (Patterns, Functions and Algebra D, 8-10)
- *Evaluate the validity of claims and predictions that are based on data by examining the appropriateness of the data collection and analysis.* (Data Analysis and Probability E, 8-10)
- *Apply mathematical knowledge and skills routinely in other content areas and practical situations.* (Mathematical Processes B, 8-10)

BIL: Essential

	12	AD	ApT
EDU:	**I**	P	R

Competency 10.15: Explain the impact of emerging technologies in manufacturing.

Descriptors:

10.15.1 Identify various uses of technology in manufacturing (e.g., scheduling, bar coding, material management, material handling, equipment, robotics).
10.15.2 Analyze the impact of technology use for the manufacturing industry.

Correlated English Language Arts Academic Content Benchmarks

- *Apply reading comprehension strategies to understand grade-appropriate texts.* (Reading Process A, 8-10; Reading Process A, 11-12)
- *Evaluate the usefulness and credibility of data and sources and synthesize information from multiple sources.* (Research C, 11-12)

Correlated Science Academic Content Benchmarks

- *Explain that science and technology are interdependent; each drives the other.* (Science and Technology B, 9-10)

BIL: **Essential**

	12	AD	ApT
EDU:	**I**	P	R

Competency 10.16: ***Describe basic metallurgy and metal processing.***

Descriptors:

10.16.1 Differentiate between different metals used in the manufacturing processes.

10.16.2 Identify processes used in metal forming (e.g., casting, metal forming, extrusion, stamping).

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

Welding

Unit 11: Safety

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

EDU:	12	AD
	P	R

Competency 11.1: Describe fumes, gases and toxic materials.

Descriptors:

11.1.1 Describe fume generation and its dangers.
11.1.2 Describe potential safety hazards with fumes.
11.1.3 Describe the possibility of toxic materials in the electrode, base metal and metal coatings.
11.1.4 Identify potential dangers of confined spaces.
11.1.5 Describe methods of ventilation and other means of protection.
11.1.6 List methods used to measure fume exposure levels.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

BIL: Essential

EDU:	12	AD
	P	R

Competency 11.2: Demonstrate gas storage safety.

Descriptors:

11.2.1 Identify cylinder contents by markings.
11.2.2 Describe the proper storage and transportation of cylinders.
11.2.3 Describe gas safety equipment.
11.2.4 Describe the required separation of fuel gases and accelerants.

BIL: Essential

EDU:	12	AD
	P	R

Competency 11.3: Demonstrate fire safety.

Descriptors:

11.3.1 Describe components needed to support a fire.
11.3.2 Describe the classes of fire extinguishers.
11.3.3 Describe welding conditions that may result in fires and the proper extinguishing techniques.
11.3.4 Employ a safety procedure for fire watch during and after welding and thermal cutting.

Unit 12: Materials Science, Inspection and Testing

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

EDU:	12	AD
	P	R

Competency 12.1: Assess materials.

Descriptors:

12.1.1 Demonstrate spark and magnetic tests to determine carbon content.
12.1.2 Demonstrate scratch tests using a file.
12.1.3 Determine the classification and physical properties of ferrous and non-ferrous metals.
12.1.4 Identify the role of carbon in ferrous metals.
12.1.5 Describe the effects of heat treatment in ferrous metals.

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

BIL: Essential

EDU:	12	AD
	P	R

Competency 12.2: Explain weld testing.

Descriptors:

12.2.1 Identify the types of welding and cutting defects by process.
12.2.2 Identify the causes of different welding and cutting defects.
12.2.3 Describe corrective actions that can be taken in response to different welding and cutting defects.
12.2.4 Describe destructive tests.
12.2.5 Describe non-destructive tests.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

BIL: Essential

EDU:	12	AD
	P	R

Competency 12.3: Predict the degree of distortion.

Descriptors:

12.3.1 Identify causes of distortion.
12.3.2 Construct weldments with pre-positioned parts.
12.3.3 Practice reducing distortion using mechanical techniques.
12.3.4 Construct weldments with a balanced welding sequence.

12.3.5 Practice reducing distortion using heating techniques.

Unit 13: Engineering Drawings

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

EDU:	**12**	**AD**
	P	R

Competency 13.1: Describe and interpret welding symbols and definitions.

Descriptors:

13.1.1 Identify the components of welding symbols.
13.1.2 Identify the five basic welding joints.
13.1.3 Complete a table of joints and basic welding symbols.
13.1.4 Apply welding symbols to simple weldment drawings.
13.1.5 Identify the parts of a welding joint.
13.1.6 Identify the parts of a finished weld.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: Essential

EDU:	**12**	**AD**
	P	R

Competency 13.2: Interpret Drawings and Prints.

Descriptors:

13.2.1 Identify the components of the drawing title block.
13.2.2 Identify the three views on a drawing.
13.2.3 Interpret drawing line types.
13.2.4 Identify the location of bills of material.
13.2.5 Identify base metals from bills of material.
13.2.6 Identify and interpret welding symbols.
13.2.7 Interpret tolerance dimensions in metric and English.
13.2.8 Construct three-view sketches from simple isometric or perspective drawings.
13.2.9 Interpret structural shapes, sizes and weights.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Draw and construct representations of two- and three-dimensional geometric objects using a variety of tools, such as straightedge, compass and technology.* (Geometry and Spatial Sense E, 8-10)

BIL: **Essential**

EDU:	**12**	**AD**
	P	R

Competency 13.3: Explain welding procedure specifications.
Descriptors:
13.3.1 Identify the components of a welding procedure specification.
13.3.2 Define welding parameters according to the data shown in welding procedures.
13.3.3 Identify the effects of operating variables.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: **Essential**

EDU:	**12**	**AD**
	P	R

Competency 13.4: Select and utilize measuring devices.
Descriptors:
13.4.1 Measure joint preparations, fit-up, joints and weld size.
13.4.2 Measure using metric and English units; a scale, combination square, protractor, measuring tape, micrometer, caliper and weld gauges.
13.4.3 Describe procedures to adjust a bevel square to a 45^{o} angle using a framing square, combination square and protractor.
13.4.4 Formulate 90^{o} and 45^{o} angles using a combination square.

Correlated Mathematics Academic Content Benchmarks

- *Apply indirect measurement techniques, tools and formulas, as appropriate, to find perimeter, circumference and area of circles, triangles, quadrilaterals and composite shapes, and to find volume of prisms, cylinders, and pyramids.* (Measurement C, 8-10)
- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

- *Explain differences among accuracy, precision and error, and describe how each of those can affect solutions in measurement situations.* (Measurement A, 11-12)
- *Apply various measurement scales to describe phenomena and solve problems.* (Measurement B, 11-12)

Unit 14: Welding Fabrication

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

EDU:	**12**	**AD**
	P	R

Competency 14.1: Demonstrate power metalworking machinery.

Descriptors:

14.1.1 Demonstrate proper safety procedures for the using power metalworking machinery.
14.1.2 Demonstrate the established procedures for using a power grinder (fixed and portable).
14.1.3 Demonstrate the established procedures for using a drill press.
14.1.4 Demonstrate the established procedures for using an iron worker.
14.1.5 Demonstrate the established procedures for using a power saw.
14.1.6 Demonstrate the established procedures for using a power shear.
14.1.7 Demonstrate the established procedures for using a press break.

Correlated Mathematics Academic Content Benchmarks

- *Estimate, compute and solve problems involving real numbers, including ratio, proportion and percent, and explain solutions.* (Number, Number Sense and Operations G, 8-10)
- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)

BIL: Essential

EDU:	**12**	**AD**
	P	R

Competency 14.2: Construct simple weldments from drawings.

Descriptors:

14.2.1 Develop welding sequences.
14.2.2 Write welding procedures.
14.2.3 Produce a weldment according to a welding procedure.
14.2.4 Compare the weldment against print specifications.
14.2.5 Analyze the quality of welds.

Correlated English Language Arts Academic Content Benchmarks

- *Produce functional documents that report, organize and convey information and ideas accurately, foresee readers' problems or misunderstandings and that include formatting techniques that are user friendly.* (Writing Applications C, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)
-

Unit 15: Oxyfuel Brazing and Soldering

(Industry-Driven Authentic Assessment, See Appendix)

BIL: **Essential**

EDU:	**12**	**AD**
	P	R

Competency 15.1: Explain oxyfuel brazing and soldering.

Descriptors:

15.1.1 Identify the difference between brazing and soldering.
15.1.2 Describe the procedure for brazing and soldering.
15.1.3 Identify the types of fuels and their applications.
15.1.4 Identify types of flames.
15.1.5 Utilize oxyfuel equipment in accordance with job requirements.
15.1.6 Identify the joint design required.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

BIL: **Essential**

EDU:	**12**	**AD**
	P	R

Competency 15.2: Demonstrate oxyfuel brazing and soldering

Descriptors:

15.2.1 Demonstrate safe procedures for the assembly and startup of oxyfuel equipment.
15.2.2 Demonstrate procedures to shut down and secure equipment.
15.2.3 Utilize size and type of filler wire and torch tip in accordance with job requirements.
15.2.4 Complete a braze or solder joint using filler wire.

Unit 16: Shielded Metal Arc Welding (SMAW)

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

EDU:	12	AD
	P	R

Competency 16.1: Explain the SMAW process.
Descriptors:
16.1.1 Describe SMAW power source operating characteristics and performance.
16.1.2 Explain the SMAW electrode classification system (AWS).
16.1.3 Describe established procedures for handling and storing electrodes.
16.1.4 Demonstrate the setup procedure for SMAW equipment.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

BIL: Essential

EDU:	12	AD
	P	R

Competency 16.2: Demonstrate SMAW of mild steel plate.
Descriptors:
16.2.1 Identify the joint design required.
16.2.2 Use the correct size and type of electrode in accordance with job requirements.
16.2.3 Demonstrate the procedures for welding fillet and groove welds in all positions.
16.2.4 Apply test procedures to the weld.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: Recommended

EDU:	12	AD
	I	P

Competency 16.3: Demonstrate SMAW of stainless steel.
Descriptors:
16.3.1 Identify the joint design required.

16.3.2 Use the correct size and type of electrode in accordance with job requirements.
16.3.3 Demonstrate the procedures for welding fillet and groove welds.
16.3.4 Apply test procedures to the weld.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: Recommended

EDU:	**12**	**AD**
	I	P

Competency 16.4: Demonstrate SMAW of mild steel pipe.
Descriptors:
16.4.1 Identify the joint design required.
16.4.2 Use the correct size and type of electrode in accordance with job requirements.
16.4.3 Demonstrate the procedures for welding fillet and groove welds.
16.4.4 Apply test procedures to weld.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: Recommended

EDU:	**12**	**AD**
	I	P

Competency 16.5: Describe SMAW hardfacing.
Descriptors:
16.5.1 Identify the base metal for hardfacing.
16.5.2 Identify the correct size and type of electrode in accordance with job requirements.
16.5.3 Identify the procedure for applying hardfacing with the weld.

BIL: Recommended

EDU:	**12**	**AD**
	I	P

Competency 16.6: Describe SMAW of cast iron.
Descriptors:
16.6.1 Identify the joint design required.
16.6.2 Identify the correct size and type of electrode in accordance with job requirements.
16.6.3 Describe the procedure for welding cast iron, including pre-heating and post-heating.

Unit 17: Thermal Cutting

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

EDU:	12	AD
	P	R

Competency 17.1: Demonstrate cutting metals using the plasma arc cutting (PAC) process.

Descriptors:

17.1.1 Describe thermal cutting power source operating characteristics and performance.
17.1.2 Identify the job requirements.
17.1.3 Demonstrate the procedure to cut metals using the PAC process.
17.1.4 Explain the causes of cutting problems and identify the corrective action needed.
17.1.5 Explain the relationship between consumable condition and cutting performance.
17.1.6 Demonstrate the proper procedure for replacing torch consumables.

Correlated English Language Arts Academic Content Benchmarks

- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

BIL: Recommended

EDU:	12	AD
	P	R

Competency 17.2: Explain cutting and gouging metals using the air carbon arc (CAC-A) process.

Descriptors:

17.2.1 Identify the job requirements.
17.2.2 Describe power sources that are suitable for CAC-A.
17.2.3 Explain the usage and types of CAC-A electrodes.
17.2.4 Demonstrate the procedure to cut and gouge metals using the carbon arc process.
17.2.5 Explain potential cutting problems and identify corrective actions.
17.2.6 Demonstrate use of proper PPE and hearing protection.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

BIL: **Essential**

EDU:	**12**	**AD**
	P	R

Competency 17.3: **Demonstrate cutting metals using manual and machine-guided oxyfuel processes.**

Descriptors:

17.3.1 Identify the types of fuels and their applications.
17.3.2 Demonstrate safe procedures for assembly and startup of oxyfuel equipment.
17.3.3 Identify types of flames.
17.3.4 Utilize oxyfuel welding equipment in accordance with job requirements.
17.3.5 Describe the procedures for shutting down and securing welding equipment.
17.3.6 Identify the job requirements
17.3.7 Demonstrate the procedure for cutting metals using the manual oxyfuel process.
17.3.8 Demonstrate the procedure for cutting metals using the machine-guided oxyfuel process.
17.3.9 Explain the causes of cutting problems and identify the corrective action needed.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

BIL: **Recommended**

EDU:	**12**	**AD**
	I	I

Competency 17.4: **Explain advanced cutting systems.**

Descriptors:

17.4.1 Describe the characteristics and functions of plasma.

17.4.2 Describe the characteristics and functions of CNC plasma cutting systems.
17.4.3 Describe the characteristics and functions of CNC oxyfuel systems.
17.4.4 Describe the characteristics and functions of laser welding.
17.4.5 Describe the characteristics and functions of CNC laser cutting.
17.4.6 Demonstrate knowledge of the characteristics and functions of pressurized-fluid cutting systems.
17.4.7 Discuss the characteristics and functions of automated welding and robotics.
17.4.8 Discuss the characteristics and functions of advanced welding processes (e.g., pulse).
17.4.9 Discuss the characteristics and functions of resistance welding.

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

Unit 18: Gas Metal Arc Welding (GMAW)

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

EDU:	**12**	**AD**
	P	R

Competency 18.1: Explain the GMAW process.

Descriptors:

18.1.1 Describe GMAW power source operating characteristics and performance.
18.1.2 Explain the GMAW electrode classification system, the American welding system (AWS).
18.1.3 Describe established procedures for handling and storing electrodes.
18.1.4 Demonstrate the setup procedure for GMAW equipment.
18.1.5 Explain the relationship between shielding gases and metal transfer.

Correlated English Language Arts Academic Content Benchmarks

- *Use multiple resources to enhance comprehension of vocabulary.* (Acquisition of Vocabulary F, 8-10; Acquisition of Vocabulary E, 11-12)
- *Demonstrate comprehension of print and electronic text by responding to questions (e.g., literal, inferential, evaluative and synthesizing).* (Reading Process B, 8-10; Reading Process B, 11-12)

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

BIL: Essential

EDU:	**12**	**AD**
	P	R

Competency 18.2: Demonstrate GMAW of mild steel.

Descriptors:

18.2.1 Identify the joint design required.
18.2.2 Use wire size and type, tip and shielding gas in accordance with job requirements.
18.2.3 Demonstrate the procedures for welding fillet and groove welds using short circuit transfer in all positions.
18.2.4 Demonstrate the procedures for welding fillet welds in the 1F and 2F positions and groove welds in the 1G position, using spray transfer.
18.2.5 Apply test procedures to the welds.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: Recommended

EDU:	**12**	**AD**
	I	P

Competency 18.3: Demonstrate GMAW of stainless steel.

Descriptors:

18.3.1 Identify the joint design required.
18.3.2 Use wire size and type, tip and shielding gas in accordance with job requirements.
18.3.3 Demonstrate the procedures for welding fillet and groove welds using short circuit transfer in all positions.
18.3.4 Demonstrate the procedures for welding fillet welds in the 1F and 2F positions and grove welds in the 1G position, using spray transfer.
18.3.5 Apply test procedures to the welds.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: Recommended

EDU:	**12**	**AD**
	I	P

Competency 18.4: Demonstrate GMAW of aluminum.

Descriptors:

18.4.1 Identify the joint design required.
18.4.2 Utilize wire size and type, tip and shielding gas in accordance with job requirements.
18.4.3 Demonstrate the procedures for welding fillet and groove welds using spray transfer in all positions.
18.4.4 Demonstrate the procedures for welding fillet and groove welds using pulses transfer in all positions.

18.4.5 Apply test procedures to the welds.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: Recommended

EDU:	**12**	**AD**
	I	P

Competency 18.5: Demonstrate GMAW of mild steel pipe.
Descriptors:
18.5.1 Identify the joint design required.
18.5.2 Utilize wire size and type, tip and shielding gas in accordance with job requirements.
18.5.3 Demonstrate the procedures for welding fillet and groove welds.
18.5.4 Apply test procedures to the weld.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

Unit 19: Flux Core Arc Welding (FCAW)

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

EDU:	**12**	**AD**
	P	R

Competency 19.1: Explain the FCAW process.
Descriptors:
19.1.1 Describe FCAW power source operating characteristics and performance.
19.1.2 Explain the FCAW electrode classification system (AWS).
19.1.3 Describe established procedures for handling and storing electrodes.
19.1.4 Demonstrate the setup procedure for FCAW equipment.
19.1.5 Explain the difference between self-shielded and gas-shielded processes.

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

BIL: Essential

EDU:	12	AD
	P	R

Competency 19.2: Demonstrate FCAW of mild steel.
Descriptors:

19.2.1 Identify the joint design required.
19.2.2 Use wire size and type, tip and shielding gas (if required) in accordance with job requirements.
19.2.3 Demonstrate the procedure to weld mild steel.
19.2.4 Demonstrate gas-shielded fillet weld in all positions.
19.2.5 Demonstrate gas-shielded groove welds in all positions.
19.2.6 Demonstrate self-shielded fillet welds in all positions.
19.2.7 Demonstrate self-shielded groove welds in all positions.
19.2.8 Apply test procedures to the welds.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: Recommended

EDU:	12	AD
	I	P

Competency 19.3: Demonstrate FCAW of stainless steel
Descriptors:

19.3.1 Identify the joint design required.
19.3.2 Use wire size and type, tip and shielding gas (if required) in accordance with job requirements.
19.3.3 Demonstrate the procedures for welding filet welds in all positions.
19.3.4 Demonstrate the procedures for welding groove welds in all positions.
19.3.5 Apply test procedures to the welds.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

Unit 20: Gas Tungsten Arc Welding (GTAW)

(Industry-Driven Authentic Assessment, See Appendix)

BIL: Essential

EDU:	12	AD
	P	R

Competency 20.1: Explain the GTAW process.

Descriptors:

20.1.1 Describe GTAW power source operating characteristics and performance.
20.1.2 Explain the GTAW electrode classification system (AWS).
20.1.3 Explain the GTAW filler metal classification system (AWS).
20.1.4 Describe established procedures for handling and storing electrodes.
20.1.5 Demonstrate the setup procedure for GTAW equipment.
20.1.6 Demonstrate the procedure for electrode preparation.

Correlated Science Academic Content Benchmarks

- *Describe the identifiable physical properties of substances (e.g., color, hardness, conductivity, density, concentration and ductility). Explain how changes in these properties can occur without changing the chemical nature of the substance.* (Physical Sciences C, 9-10)

BIL: Essential

EDU:	12	AD
	P	R

Competency 20.2: Demonstrate GTAW of mild steel.

Descriptors:

20.2.1 Identify the joint design required.
20.2.2 Use electrode type and size, filler metal and shielding gas in accordance with job requirements.
20.2.3 Demonstrate the procedure to weld mild steel.
20.2.4 Demonstrate fillet wilds in all positions.
20.2.5 Demonstrate groove welds in all positions.
20.2.6 Apply test procedures to the welds.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: Essential

EDU:	12	AD
	P	R

Competency 20.3: Demonstrate GTAW of stainless steel.
Descriptors:

20.3.1 Identify the joint design required.
20.3.2 Use electrode type and size, filler metal and shielding gas in accordance with job requirements.
20.3.3 Demonstrate the procedures for welding groove welds in the 1G and 2G positions.
20.3.4 Demonstrate the procedures for welding fillet welds in the 1F, 2F and 3F positions.
20.3.5 Apply test procedures to the welds.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: Essential

EDU:	**12**	**AD**
	P	R

Competency 20.4: Demonstrate GTAW of aluminum.
Descriptors:

20.4.1 Identify the joint design required.
20.4.2 Use electrode type and size, filler metal and shielding gas in accordance with job requirements.
20.4.3 Demonstrate the procedure to weld aluminum.
20.4.4 Demonstrate fillet welds in the 1F and 2F positions.
20.4.5 Demonstrate a groove weld in the 1G position.
20.4.6 Apply test procedures to the welds.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

BIL: Recommended

EDU:	**12**	**AD**
	I	P

Competency 20.5: Demonstrate GTAW of mild steel pipe.
Descriptors:

20.5.1 Identify the joint design required.
20.5.2 Use electrode type and size, filler metal and shielding gas in accordance with job requirements.
20.5.3 Demonstrate the procedures for welding fillet and groove welds.
20.5.4 Apply test procedures to the weld.

Correlated Mathematics Academic Content Benchmarks

- *Estimate and compute various attributes, including length, angle measure, area, surface area and volume, to a specified level of precision.* (Measurement E, 8-10)
- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

Unit 21: Advanced Welding Systems

(Industry-Driven Authentic Assessment, See Appendix)

BIL: **Recommended**

EDU:	**12**	**AD**
	I	P

Competency 21.1: Discuss trends, issues and impacts of emerging technologies in welding.

Descriptors:

21.1.1 Identify emerging welding systems and processes.
21.1.2 Discuss the issues and impacts emerging technologies will have on the welding industry.
21.1.3 Differentiate the economic impact of emerging systems and processes from traditional system and processes (i.e., costs vs. quality or labor saving).

Correlated English Language Arts Academic Content Benchmarks

- *Compile, organize and evaluate information, take notes and summarize findings.* (Research B, 11-12)

Correlated Mathematics Academic Content Benchmarks

- *Create and analyze tabular and graphical displays of data using appropriate tools, including spreadsheets and graphing calculators.* (Data Analysis and Probability A, 11-12)

Correlated Science Academic Content Benchmarks

- *Explain that science and technology are interdependent; each drives the other.* (Science and Technology B, 9-10)

BIL: **Recommended**

EDU:	**12**	**AD**
	I	P

Competency 21.2: Explain advanced welding systems

Descriptors:

21.2.1 Describe the characteristics and functions of plasma welding.
21.2.2 Discuss the characteristics and functions of laser welding.
21.2.3 Describe the characteristics and functions of automated welding and robotics.
21.2.4 Discuss the characteristics and functions of advanced welding processes (e.g., pulse).
21.2.5 Describe the characteristics and functions of resistance welding.

Technology Standards

Standard 1: Nature of Technology

Students develop an understanding of technology, its characteristics, scope, core concepts* and relationships between technologies and other fields.

Benchmark A: Synthesize information, evaluate and make decisions about technologies.

Benchmark B: Apply technological knowledge in decision-making.

Benchmark C: Examine the synergy between and among technologies and other fields of study when solving technological problems.

Standard 2: Technology and Society Interaction

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.

Benchmark A: Interpret and practice responsible citizenship relative to technology.

Benchmark B: Demonstrate the relationship among people, technology and the environment.

Benchmark C: Interpret and evaluate the influence of technology throughout history, and predict its impact on the future.

Benchmark D: Analyze ethical and legal technology issues and formulate solutions and strategies that foster responsible technology usage.

Benchmark E: Forecast the impact of technological products and systems.

Standard 3: Technology for Productivity Applications

Students learn the operations of technology through the usage of technology and productivity tools.

Benchmark A: Integrate conceptual knowledge of technology systems in determining practical applications for learning and technical problem-solving.

Benchmark B: Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.

Standard 4: Technology and Communication Applications

Students use an array of technologies and apply design concepts to communicate with multiple audiences, acquire and disseminate information and enhance learning.

Benchmark A: Apply appropriate communication design principles in published and presented projects.

Benchmark B: Create, publish and present information, utilizing formats appropriate to the content and audience.

Benchmark C: Identify communication needs, select appropriate communication tools and design collaborative interactive projects and activities to communicate with others, incorporating emerging technologies.

Standard 5: Technology and Information Literacy

Students engage in information literacy strategies, use the Internet, technology tools and resources, and apply information-management skills to answer questions and expand knowledge.

Benchmark A: Determine and apply an evaluative process to all information sources chosen for a project.

Benchmark B: Apply a research process model to conduct research and meet information needs.

Benchmark C: Formulate advanced search strategies, demonstrating an understanding of the strengths and limitations of the Internet, and evaluate the quality and appropriate use of Internet resources.

Benchmark D: Evaluate choices of electronic resources and determine their strengths and limitations.

Standard 6: Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

Benchmark A: Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

Benchmark B: Recognize the role of teamwork in engineering design and of prototyping in the design process.

Benchmark C: Understand and apply research, development and experimentation to problem-solving.

Standard 7: Designed World

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future, issues and career connections.

Benchmark A: Classify, demonstrate, examine, and appraise energy and power technologies.

Benchmark B: Classify, demonstrate, examine and appraise transportation technologies.

Benchmark C: Classify, demonstrate, examine and appraise manufacturing technologies.

Benchmark D: Classify, demonstrate, examine and appraise construction technologies.

Benchmark E: Classify, demonstrate, examine and appraise information and communication technologies

Benchmark F: Classify, demonstrate, examine and appraise medical technologies.

Benchmark G: Classify, demonstrate, examine and appraise agricultural and related biotechnologies.

Performance Measures/Student Assessment/Instructional Strategies

Assessments/Evaluations

- Observations
- Demonstrations
- Portfolios
- Standardized Tests
- Class Assignment
- Quizzes/Tests/Exams
- Web Exam/Certification

Instructional Strategies

- Teacher-Directed & Student-Centered Activities
- Case Study Problem Solving
- Cooperative Learning
- Project-Based Learning
- Career-Based Learning (Internships/Shadowing/Placement)
- Community-Based Learning (CTSOs and Other)
- Exploratory Learning
- Independent Research
- Team Teaching

Content Specific Strategies