

<b>Advanced Welding</b>		<b>Grades 9-12</b>	
<b>Standards</b>		<b>Benchmarks</b>	<b>Activities/Examples</b>
1. Students will develop an understanding of the characteristics and scope of technology.	L	The rate of technological development and diffusion is increasing rapidly.	Students are required to identify a need either of their own or family/friends' that pertains to welding. The students are then required to research how to either repair or build something using their welding skills to solve the problem.
	M	Most development of technologies these days is driven by the profit motive and the market.	Students' projects are designed by the students and must have a materials list including cost of materials before project approval. The project has to be cost effective.
2. Students will develop an understanding of the core concepts of technology.	X	Systems, which are the building blocks of technology, are embedded within larger technological, social, and environmental systems.	Students learn how welding impacts other technologies, the economy, and the environment.
	Z	Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste.	Students need to select the appropriate metal to use on their projects weighing the trade-off between cost, strength, durability, weight, and appearance.
	BB	Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.	Students build required projects that have specific criteria and directions.
	CC	New technologies create new processes.	Students learn how to use old and new welding processes and weigh pros and cons of each process.
	DD	Quality control is a planned process to ensure that a product, service, or system meets established criteria.	All of the students' projects and welds must meet the instructor's quality criteria to pass the course.
3. Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.	J	Technological progress promotes the advancement of science and mathematics.	Welding is completely based on metallurgy which is the science and study of manipulating metal to meet specific purposes.
4. Students will develop an understanding of the cultural, social, economic, and political effects of technology.	I	Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.	Students are required to complete projects in which they choose the best method of joining metal.
	K	The transfer of a technology from one society to another can cause cultural, social, economic, and political changes affecting both societies to varying degrees.	Oceanic (underwater) welding is described and its effects on the countries involved. The underwater welding may be for communications, pipelines, or oil drilling all of which become political concerns.

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5. Students will develop an understanding of the effects of technology on the environment.	G	Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling.	The students are required to perform welds on new material. Those welds are then either recycled or melted down. If melted down, students are to reshape and mold their reused material into desired shapes.
	H	When new technologies are developed to reduce the use of resources, considerations of trade-offs are important.	Students learn about the costs of several types of welding processes. Some of these processes are very old. These processes are compared to new welding processes and students must consider cost, speed, difficulty, and effectiveness when selecting the type of welder for each project.
6. Students will develop an understanding of the role of society in the development and use of technology.	H	Different cultures develop their own technologies to satisfy their individual and shared needs, wants, and values.	The foundry lesson describes how different cultures have impacted and been impacted by the use of metal. It also describes what increases innovation such as war or religion.
7. Students will develop an understanding of the influence of technology on history.	G	Most technological development has been evolutionary, the result of a series of refinements to a basic invention.	The welding processes that are learned all have commonalities in how they operate. These similarities are because the processes have evolved from one another through history.
	H	The evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools and materials.	The foundry lesson teaches students how metal-work has impacted history as well as how historical events have affected metal-work.
	N	The Industrial Revolution saw the development of continuous manufacturing, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time.	The foundry lesson teaches students how companies like John Deere became successful during the Industrial Revolution.
8. Students will develop an understanding of the attributes of design.	H	The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype, testing and evaluating the design using specifications, refining the design, creating or making it, and communicating processes and results.	In Advanced Welding students are required to design and build a project to meet a need using the design process as described by this benchmark.
	K	Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.	Students need to select the appropriate metal to use on their projects weighing the trade-off between cost, strength, durability, weight, and appearance.

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10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.	J	Technological problems must be researched before they can be solved.	During the repair unit, students are required to research and identify the metal they have acquired and discover the most appropriate method of repair.
11. Students will develop the abilities to apply the design process.	M	Identify the design problem to solve and decide whether or not to address it.	Students design projects to meet specific needs. They need to decide which needs should prevail over others.
	N	Identify criteria and constraints and determine how these will affect the design process.	Students' designed projects must fall within course curriculum constraints.
	Q	Develop and produce a product or system using a design process.	In Advanced Welding students are required to design and build a project to meet a need using the design process as described by this benchmark.
16. Students will develop an understanding of and be able to select and use energy and power technologies.	J	Energy cannot be created nor destroyed; however, it can be converted from one form to another.	Welding processes need heat which is a form of energy. Students use a variety of welders that require various forms of energy input and convert them to heat using different methods.
19. Students will develop an understanding of and be able to select and use manufacturing technologies.	M	Durable goods are designed to operate for a long period of time, while non-durable goods are designed to operate for a short period of time.	Students use different metals and welding gasses both of which have subcategories or classifications of natural, synthetic, or mixed.
	O	Manufacturing systems may be classified into types, such as customized production, batch production, and continuous production.	Students learn the difference between mass-production and customized-production when working on their projects.
	P	The interchangeability of parts increases the effectiveness of manufacturing processes.	Students are required to maintain and repair welding equipment. The parts and basic operation for the machines, though different by brand are commonly interchangeable thus making repairs more efficient.
20. Students will develop an understanding of and be able to select and use construction technologies.	K	Structures are constructed using a variety of processes and procedures.	The careers unit shows students the impact structural welding has on the construction field and how all contractors must collaborate.
	L	The design of structures includes a number of requirements.	The welding blue print reading unit teaches students to read requirements mandated by engineers.