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Unit:	**Product Design**
Big Ideas:	All products, large or small, have been designed to serve a specific purpose. The size and shape of said product is controlled by the elements and principles of design.
Unit Essential Questions:	How is the appearance of a product controlled by the elements and principles of design?

Concept & Pacing	New Emphasis (Pa Core Standard)	Key Vocabulary	Essential Questions	Mini-Lessons/Activities	Instructional Materials	Assessments
Product Design 2 Weeks	3.4.12.B1. Analyze ethical, social, economic, and cultural considerations as related to the development, selection, and use of **technologies**. 3.4.12.C3. Apply the concept that many technological problems require a multi-disciplinary approach. **CC.2.4.4.A.6** Measure angles and use properties of adjacent angles to solve problems. **CC.2.1.7.D.1** Analyze proportional relationships and use them to model and solve real-world and mathematical problems. **CC.2.1.HS.F.3** Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. **CC.3.5.9-10.D:** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical	Product Form Function Shape Safety Reliability Tolerance Part Assembly End User	What are the elements of product design? How is the appearance of a product controlled by the elements and principles of design?	Lectures Writing prompts Product Design Challenge Class discussions	Modern Metalworking Textbook Worksheets Elmo / presentation materials Handouts	Participation Homework Test – t/f, m/c, short answer

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	context relevant to grades 9–10 texts and topics.					
Unit:	Introduction to CAD software					
Big Ideas:	Drafting in the 21st century is largely dependent on computerized technologies. These technologies enable designers and engineers to collaborate during the design and development of parts and assemblies, and make changes quickly and efficiently to meet the demands of the consumer.					
Unit Essential Questions:	How is computer technology used to create, alter, and test product designs before manufacture?					
Autocad/Fusion 360 **4 Weeks**	3.4.10.B4. Recognize that technological development has been evolutionary, the result of a series of refinements to a basic **invention**. 3.4.10.E7. Evaluate structure design as related to function, considering such factors as style, convenience, safety, and efficiency. **CC.2.1.7.D.1** Analyze proportional relationships and use them to model and solve real-world and mathematical problems. **CC.2.1.HS.F.3** Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. **CC.3.5.11-12.G:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	User Interface Property Manager Basic Geometry Dimensions Geometric Relationships	How are 3D features used to create 3D parts in Fusion 360? In what way are parts and assemblies related? What types of information are communicated on a drawing?	Lecture Class Discussion Basic Functionality of Autocad and Fusion 360 Assembly Drawing	Autocad Software Autocad Student Guide Autocad Tutorials Sketching Materials Elmo / presentation materials	Participation 5-Minute quiz Test – t/f, m/c, short answer, Engineering Drawing Rubric

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Unit:	Production Run Design					
Big Ideas:	Designing, manufacturing, and testing are all crucial components in creating a usable product.					
Unit Essential Questions:	How does the design, manufacture, and testing of products affect the world in which we live?					
Production Run Design **3 Weeks**	3.4.10.B4. Recognize that technological development has been evolutionary, the result of a series of refinements to a basic **invention**. 3.4.10.E7. Evaluate structure design as related to function, considering such factors as style, convenience, safety, and efficiency. **CC.2.1.7.D.1** Analyze proportional relationships and use them to model and solve real-world and mathematical problems. **CC.2.1.HS.F.3** Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. **CC.3.5.11-12.G:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	Autocad Fusion 360 Drawing Part Assembly Plane Extrude Cut Array Extruded Cut Fillet Round Dimension Tolerance Part Assembly Drawing	How is the form of a product dictated by its function? What information is needed from a client to design a product? What is the meaning of the phrase: Form Follows Function? How are assemblies constructed from parts in Fusion 360?	Lecture	Lab materials Handouts Class discussion Autocad Fusion 360	Class Projects Homework Quiz – t/f, m/c Tests – t/f, m/c, short answer Grading Rubric

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Unit:	Production Run					
Big Ideas:	Manufacturing is the process by which we create products to make our lives easier.					
Unit Essential Questions:	How do designers and engineers determine which manufacturing process to employ to create a product?					
Production Run **Advanced Milling Operations** **Product Testing** **4 Weeks**	3.4.10.B4. Recognize that technological development has been evolutionary, the result of a series of refinements to a basic **invention**. 3.4.10.E7. Evaluate structure design as related to function, considering such factors as style, convenience, safety, and efficiency. 3.4.10.C1. Apply the components of the technological design process. 3.4.12.C3. Apply the concept that many technological problems require a multi-disciplinary approach. **CC.2.4.4.A.6** Measure angles and use properties of adjacent angles to solve problems. **CC.2.1.7.D.1** Analyze proportional relationships and use them to model and solve real-world and mathematical problems.	Metal Lathe Milling Machine SMAW Sheet Metal Forge	How are manufacturing processes used to create a product? How are manufacturing processes selected?	Lecture Windmill Manufacture Advanced Milling Operations	Handouts Calculators 3D Printer Elmo / presentation materials General lab equipment	Participation Homework Tests – t/f, m/c, short answer, calculations Grading Rubric

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	CC.2.1.HS.F.3 Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. **CC.3.5.11-12.G:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.					
Unit:	Broaching and Extruding					
Big Ideas:	Broaching is a manufacturing process for machining flat, rounded, and contoured surfaces. Extrusion is the process of shaping solid metal by forcing it under high pressure through an opening in a die.					
Unit Essential Questions:	How are broaching and machining processes used in the manufacture of products?					
Broaching **Extruding** **1.5 Weeks**	3.4.10.B4. Recognize that technological development has been evolutionary, the result of a series of refinements to a basic **invention**. 3.4.10.E7. Evaluate structure design as related to function, considering such factors as style, convenience, safety, and efficiency. 3.4.10.C1. Apply the components of the technological design process.	Broach Burnishing Key Keyway Billet Extrusion Ingot Slug Die	In what ways is broaching used in consumer gods? Why is extruding a preferred method of manufacture for certain goods?	Lecture Extrusion Activity	Modern Metalworking Textbook Extrusion Examples Broaching Examples Play-doh Play-doh Extruder 3D Printer	Participation Homework Test – t/f, m/c, short answer

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	3.4.12.C3. Apply the concept that many technological problems require a multi-disciplinary approach. **CC.2.4.4.A.6** Measure angles and use properties of adjacent angles to solve problems. **CC.2.1.7.D.1** Analyze proportional relationships and use them to model and solve real-world and mathematical problems. **CC.2.1.HS.F.3** Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays. **CC.3.5.11-12.G:** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.					
Unit:	Nontraditional Machining					
Big Ideas:	Because the range of materials used in the metalworking industry, new metalworking techniques have been designed to work them.					
Unit Essential Questions:	How do nontraditional metalworking techniques differ from conventional machining processes?					

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Powder Metallurgy **Nontraditional Machining Techniques** **1 Week**	3.4.12.C3. Apply the concept that many technological problems require a multi-disciplinary approach. 3.4.10.B1. Compare and contrast how the use of **technology** involves weighing the trade-offs between the positive and negative effects.	Briquette Coining Lapping Sintering Chemical Machining Electrical Discharge Machining Electrochemical Machining Electron Beam Machining Explosive Forming Hydrodynamic Machining Impact Machining Ultrasonic Machining	What is the powder metallurgy process? How do nontraditional machining techniques differ from conventional machining processes?	Lecture	Modern Metalworking textbook Handouts Elmo / presentation materials	Homework Quiz – t/f, m/c Test – t/f, m/c, short answer
Unit:	Quality Control					
Big Ideas:	The primary purpose of quality control is to seek out and prevent potential product defects in the manufacturing process before they can cause injuries or damage and substandard products.					
Unit Essential Questions:	What is the goal of quality control?					

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Quality Control **Materials Testing** **2 Weeks**	3.4.12.C3. Apply the concept that many technological problems require a multi-disciplinary approach. 3.4.10.B1. Compare and contrast how the use of **technology** involves weighing the trade-offs between the positive and negative effects. 3.4.10.C2. Analyze a **prototype** and/or create a working model to test a design concept by making actual observations and necessary adjustments.	Coordinate Measuring Machine Destructive Testing Inspection Nondestructive Testing Statistical Quality Control	What role does quality control serve in the manufacturing process? How does materials testing contribute to the manufacturing process?	Lecture Go-Gauge Usage and Application Destructive Testing	Modern Metalworking Textbook Handouts Elmo / presentation materials	Homework Test – t/f, m/c, Short Answer

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Unit:	Numerical Control and Automation
Big Ideas:	Machine tools can use several methods of control. These methods include manual, automatic, fixed-cycle, and numerical control. The quantity, quality, or complexity of the required part(s) determines the process to be used.
Unit Essential Questions:	What is automation, and what is its application in manufacturing?

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Numerical Control **1.5 Weeks**	3.4.12.C3. Apply the concept that many technological problems require a multi-disciplinary approach. 3.4.10.B1. Compare and contrast how the use of **technology** involves weighing the trade-offs between the positive and negative effects.	Automation Cartesian Coordinate System Computer Numerical Control Direct Numerical Control Flexible Manufacturing Just-In-Time Manufacturing Numerical Control	What is automation? What are the methods for controlling machine tools? How are robotics used in manufacturing?	Lecture	Modern Machining Textbook	Homework Test – t/f, m/c, short answer