Scope and Sequence for **Computer Aided Drafting and Design**

The Nature of Technology

National Standards for Technological Literacy	PA Standards for Science and Technology and Engineering Education
1. The characteristics and scope of technology. **9-12.J** The nature and development of technological knowledge and processes are functions of the setting. **9-12.L** Inventions and innovations are the results of specific, goal-directed research. .	**1. Characteristics of Technology** **3.4.12.A1** Compare and contrast the rate of technological development over time.
2. The core concepts of technology. **9-12.W** Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems. **9-12.Y** The stability of a technological system is influenced by all of the components in the system, especially those in the feedback loop. **9-12.AA** Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. **9-12.DD** Quality control is a planned process to ensure that a product, service, or system	**2. Core Concepts of Technology** **3.4.12.A2** Describe how management is the process of planning, organizing, and controlling.
3. The relationships among technologies and the connections between technology and other fields. **9-12.H** Technological innovation often results when ideas, knowledge, or skills are shared within a technology, among technologies, or across other fields.	**3. Technology Connections** **3.4.10.A3** Examine how technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function. **3.4.12.A3** Demonstrate how technological progress promotes the advancement of science, technology, engineering and mathematics (STEM).

Technology and Society

National Standards for Technological Literacy	PA Standards for Science and Technology and Engineering Education
4. The cultural, social, economic, and political effects of technology. **9-12.I** Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects. **9-12.J** Ethical considerations are important in the development, selection, and use of technologies.	**1. Effects of Technology** **3.4.10.B1** Compare and contrast how the use of technology involves weighing the trade-offs between the positive and negative effects.
5. The effects of technology on the environment. **9-12.J** The alignment of technological processes with natural processes maximizes performance and reduces negative impacts on the environment. **9-12.K** Humans devise technologies to reduce the negative consequences of other technologies. **9-12.L** Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment.	**2. Technology and Environment** **3.4.10.B2** Demonstrate how humans device technologies to reduce the negative consequences of other technologies.
6. The role of society in the development and use of technology. **9-12.H** Different cultures develop their own technologies to satisfy their individual and shared needs, wants, and values. **9-12.I** The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.	**3. Society and Development of Technology** **3.4.10.B3** Compare and contrast how a number of different factors, such as advertising, the strength of the economy, the goals of a company, and the latest fads, contribute to shaping the design of and demand for various technologies
7. The influence of technology on history. **9-12.G** Most technological development has been evolutionary, the result of a series of refinements to a basic invention. **9-12.I** Throughout history, technology has been a powerful force in reshaping the social, cultural, political, and economic landscape. **9-12.N** The Industrial Revolution saw the development of continuous manufacturing, sophisticated transportation and communication systems, advanced construction practices, and improved education and leisure time. **9-12.O** The Information Age places emphasis on the processing and exchange of information.	**4. Technology and History** **3.4.10.B4** Recognize that technology development has been evolutionary, the result of a series of refinements to a basic invention.

Design

National Standards for Technological Literacy	PA Standards for Science and Technology and Engineering Education
8. The attributes of design. **9-12.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. **9-12.J** The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.	**1. Design Attributes** **3.4.10.C1** Apply the components of the technological design process.
9. Engineering design. **9-12.I** Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. **9-12.K** A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. **9-12.L** The process of engineering design takes into account a number of factors.	**2. Engineering Design** **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. **3.4.12.C2** Apply the concept that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.
10. The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. **9-12.I** Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace. **9-12.J** Technological problems must be researched before they can be solved.	**3. Research & Development, Invention & Innovation, Experimentation/Problem Solving and Troubleshooting** **3.4.12.C3** Apply the concept that many technological problems require a multi-disciplinary approach.

Abilities for a Technological World

National Standards for Technological Literacy	PA Standards for Science and Technology and Engineering Education
11. Apply the design process. **9-12.M** Identify the design problem to solve and decide whether or not to address it. **9-12.O** Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. **9-12.Q** Develop and produce a product or system using a design process. **9-12.R** Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.	**1. Applying the Design Process** **3.4.10.D1** Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of a final product.
12. Use and maintain technological products and systems. **9-12.N** Troubleshoot, analyze, and maintain systems to ensure safe and proper function and precision. **9-12.O** Operate systems so that they function in the way they were designed. **9-12.P.** Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate.	**2. Using and Maintaining Technological Systems** **3.4.10.D2** Diagnose a malfunctioning system and use tools, materials, and knowledge to repair it. **3.4.12.D2** Verify that engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly.
13. Assess the impact of products and systems. **9-12.J** Collect information and evaluate its quality	**3. Assessing Impact of Products and Systems** **3.4.10.D3** Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual society, and the environment.

The Designed World

National Standards for Technological Literacy	PA Standards for Science and Technology and Engineering Education
17. Information and communication technologies. **9-12.L** Information and communication technologies include the inputs, processes, and outputs associated with sending and receiving information. **9-12.O** Communication systems are made up of source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination. **9-12.P** There are many ways to communicate information, such as graphic and electronic means. **9-12.Q** Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.	**4. Information and Communication Technologies** **3.4.10.E4** Evaluate the purpose and effectiveness of information and communication systems.
19. Manufacturing technologies. **9-12.M** Materials have different qualities and may be classified as natural, synthetic, or mixed. **9-12.O** Manufacturing systems may be classified into types, such as customized production, batch production, and continuous production. **9-12.P** The interchangeability of parts increases the effectiveness of manufacturing processes.	**6. Manufacturing Technologies** **3.4.10.E6** Illustrate how manufacturing systems may be classified into types such as customized production, batch production, and continuous production. **3.4.12.E6** Compare and contrast the importance of science, technology, engineering and math (STEM) as it pertains to the manufactured world.

Pennsylvania Core Standards for Reading in Science and Technical Subjects

Key Ideas and Details

CC.3.5.9-10.A. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

CC.3.5.11-12.B. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CC.3.5.9-10.C. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Craft and Structure

CC.3.5.11-12.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 context relevant to grades 11–12 texts and topics.

CC.3.5.9-10.E. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

CC.3.5.9-10.F. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Ideas

CC.3.5.9-10.G. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CC.3.5.9-10.H. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.

Range and Level of Complex Texts

CC.3.5.9-10.J. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

CC.3.5.11-12.J. By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

Pennsylvania Core Standards for Writing in Science and Technical Subjects

Text Types and Purposes

CC.3.6.9-10.A. Write arguments focused on *discipline-specific content.*
- Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- Provide a concluding statement or section that follows from or supports the argument presented.

CC.3.6.11-12.A. Write arguments focused on *discipline-specific content.*
- Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
- Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

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Text Types and Purposes
CC.3.6.9-10.B. *
Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

CC.3.6.11-12.B. * Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
- Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).

Production and Distribution of Writing
CC.3.6.9-10.C. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CC.3.6.9-10.D. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

CC.3.6.9-10.E. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
CC.3.6.11-12.E. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge
CC.3.6.9-10.G. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
CC.3.6.11-12.G. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
CC.3.6.11-12.H. Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing
CC.3.6.11-12.I. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.