SOUTHERN LEHIGH SCHOOL DISTRICT
5775 Main Street
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Scope and Sequence for **Honors Introduction to Engineering 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.L** Inventions and innovations are the results of specific, goal-directed research.	**1. Characteristics of Technology** **3.4.7.A1** Explain how technology is closely linked to creativity, which has resulted in innovation and invention. **3.4.10.A1** Illustrate how the development of technologies is often driven by profit and economic market
2. The core concepts of technology. **9-12.Z** Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste. **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.BB** Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. **9-12.DD** Quality control is a planned process to ensure that a product, service, or system meets established criteria.	**2. Core Concepts of Technology** **3.4.10.A2** Interpret how systems thinking applies logic and creativity with appropriate comprises in complex real-life problems.

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.H** Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious. **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. 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 devise technologies to reduce the negative consequences of other technologies.

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.I** Design problems are seldom presented in a clearly defined form. **9-12.J** The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. **9-12.K** Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.	**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.J** Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. **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.
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. **9-12.L** Many technological problems require a multidisciplinary approach.	**3. Research & Development, Invention & Innovation, Experimentation/Problem Solving and Troubleshooting** **3.4.10.C3** Illustrate the concept that not all problems are technological and not every problem can be solved using technology.

Abilities for a Technological World

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11. Apply the design process. **9-12.M** Identify the design problem to solve and decide whether or not to address it. **9-12.N** Identify criteria and constraints and determine how these will affect the design process. **9-12.O** Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. **9-12.P** Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed. **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.L** Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. **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.
13. Assess the impact of products and systems. **9-12.K** Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.	**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.M** Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine. **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.

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.3.5.9-10.B. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
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.3.5.9-10.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 context relevant to grades 9–10 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.
CC.3.5.9-10.I. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

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.

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.*

- Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
- Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
- Use words, phrases, and clauses 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.
- 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.3.6.9-10.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.
- Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
- Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
- 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 and supports the information or explanation presented (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.

Research to Build and Present Knowledge

CC.3.6.9-10.F. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

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.3.6.9-10.H. Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

CC.3.6.9-10.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.