Grades 9–12

3.5.9-12.MM Technology and Engineering: Nature and Characteristics of Technology and Engineering

Students who demonstrate understanding can *troubleshoot and improve a flawed system embedded within a larger technological, social, or environmental system.*

Clarifying Statement: Systems are made up of components (i.e., subsystems). A food processor is only one component in a larger food preparation system that, in turn, is a component in a larger home system. Troubleshooting a flawed system or product allows students to identify possible areas for improvement. For example, a recycling program at their school might have very low participation rates by students and staff members. Investigating the components of the program (system) will help students identify ways to improve it.

Assessment Boundary: N/A

Science and Engineering Practices (SEP)	Disciplinary Core Ideas (DCI)	Technology and Engineering Practices (TEP)
Asking Questions and Defining Problems Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	**Maintenance and Troubleshooting** • Analyze a system malfunction using logical reasoning (such as a fault tree) and appropriate diagnostic tools and instruments. Devise strategies and recommend tools for fixing the problem. **Transfer Knowledge** • Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.	**Making and Doing** • Demonstrates the ability to regulate and improve making and doing skills. **Systems Thinking** • Designs and troubleshoots technological systems in ways that consider the multiple components of the system. **Optimism** • Shows persistence in addressing technological problems and finding solutions to those problems.

Pennsylvania Context: N/A

Pennsylvania Career Ready Skills: Situate self in any social context as a means to determine a response.

Connections to Other Standards Content and Practices

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas	CC.1.2.3.G: Use information gained from text features to demonstrate understanding of a text. CC.1.2.4.G: Interpret various presentations of information within a text or digital source and explain how the information contributes to an understanding of text in which it appears. CC.1.2.5.G: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. CC.1.4.3.V: Conduct short research projects that build knowledge about a topic. CC.1.4.4.V: Conduct short research projects that build knowledge through investigation of different aspects of a topic.

Standard Source	Possible Connections to Other Standard(s) or Practice(s)
PA Core Standards: Reading and Writing in Science and Technical Areas (continued)	CC.1.4.5.V: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. CC.1.4.3.W: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. CC.1.4.4.W: Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. CC.1.4.5.W: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
PA Core Standards and Practices: Math	N/A
Integrated Standards for Science, Environment & Ecology, and Technology & Engineering Standards Grades K–12	3.3.9-12.Q: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.