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| **MS-ETS-ETSS Links Among Engineering, Technology, Science, and Society** |
| Students who demonstrate understanding can:  **a. Provide examples to explain how advances in engineering have resulted in new tools and instruments for measurement, exploration, modeling, and computation that enable new scientific discoveries, which in turn lead to the development of entire industries and engineered systems.** [Clarification Statement: Examples include: microscopes enabled the germ theory of disease, which led to the development of antibiotics, stimulating growth of the pharmaceutical industry; discoveries in physics led to development of the integrated circuit, and computers, leading to many scientific breakthroughs, and spawning new industries.]  **b. Obtain, evaluate, and communicate information about a technology that draws on natural resources to improve health of people and the natural environment, and was eventually found to have negative impacts, requiring regulations on its use or new technologies to reduce its negative impacts.** [Clarification Statement: Examples include the introduction of new chemicals for refrigeration that were less toxic, but were later found to reduce the ozone layer; the adoption of fossil fuels for energy that eliminated the need to decimate forests for heating and cooking, but were later found to change the atmosphere and climate.]  **c. Construct an explanation for how a technological system has changed over time, based on evidence about how these changes were driven by: (1) people’s changing needs, desires, and values, (2) the findings of scientific research, and (3) factors such as climate, natural resources, and economic conditions.** [Clarification Statement: Use diagrams, timelines, or other representations to show factors that have shaped a major technological system over time (e.g., energy, transportation, manufacturing, food production and distribution).] [Assessment Boundary: Explanations do not need to include all possible factors or be quantitative.]  **d. Construct arguments for and against the development of a new technology based on potential short and long term impacts (positive and negative) on the health of people, and the natural environment.** [Clarification Statement: Students should consider the pros and cons of different new technologies such as maglev rail, genetically engineered crops, wearable computers, human space travel, and new energy systems that exploit renewable resources.] |

**NEXT GENERATION SCIENCE – ENGINEERING CONNECTION**

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| **HS-ETS-ETSS Links Among Engineering, Technology, Science, and Society** |
| Students who demonstrate understanding can:  **a. Plan and carry out an investigation to improve a technology and suggest ideas for further related scientific study.** [Clarification Statement: For example, a group of students investigate the environmental conditions needed to maintain a healthy aquatic population, apply findings to improving an aquarium, and recommend research that can be done with the improved technology to study aquatic ecosystems.]  **b. Gather evidence to evaluate different explanations for the widespread adoption of a modern technology, including the role of societal demands, market forces, evaluations by scientists and engineers, and possible government regulation.** [Clarification Statement: For example, students evaluate explanations for the rapid spread of cell phones, LED lighting, or genetically engineered crops for farming.)  **c. Analyze data to compare different technologies designed to accomplish the same function regarding their relative environmental impacts, costs, risks, and benefits, and what may need to be done to reduce unanticipated negative effects.** [Clarification Statement: Comparisons include paper vs. electronic books, nuclear vs. coal-fired power plants.] [Assessment Boundary: Analysis limited to data available online or provided to students.]  **d. Construct or critique arguments based on evidence concerning the costs, risks, and benefits of changes in major technological systems related to agriculture, health, water, energy, transportation, manufacturing, or construction, needed to support a growing world population.** [Clarification Statement: For example, students construct arguments concerning the costs and benefits of shifting from centralized to distributed energy generation systems or natural to genetically engineered crops.] [Assessment Boundary: Limited to relative comparison of costs and benefits of different technological changes.] |