

Science in A Technical World
correlated with
Pennsylvania Proposed Academic Standards for Science and Technology

3.1 Unifying Themes

Grade 10

- B. Describe concepts of models as a way to predict and understand science and technology.**
- Distinguish between different types of models and modeling techniques and apply their appropriate use in specific applications (e.g., kinetic gas theory, DNA) **Plant 16, 18-27; Food 25, 84; Drugs 37, 40, 42, 44, 46**
 - Examine the advantages of using models to demonstrate processes and outcomes (e.g., blue print analysis, structural stability). **Polymer 16-19; Wastewater 25-27; Drugs 44; Plant 22, 26, 28; Pulp 19; Paint 22**
- E. Describe patterns of change in nature, physical and man made systems.**
- Describe how fundamental science and technology concepts are used to solve practical problems (e.g., momentum, Newton's laws of universal gravitation, tectonics, conservation of mass and energy, cell theory, atomic theory, theory of relativity, Galileo's Heliocentric Solar System, gas laws, feedback systems. **Plant 23-27; Wastewater 14; Paint 54; Food 18-19, 21, 46**
 - Describe changes to matter caused by heat, cold, light or chemicals using a rate function. **Polymer 17; Wastewater 14; Paint 40-42, 67, Petroleum 6-7**

Grade 12

- E. Evaluate change in nature, physical systems and man made systems**
- Evaluate fundamental science and technology concepts and their development over time (e.g., DNA, cellular respiration, unified field theory, energy measurement, automation, miniaturization, Copernican and Ptolemaic universe theories) **Plant 18-27, 44; Petroleum 26, 58; Wastewater 44**

3.2 Inquiry and Design

Grade 10

- B. Apply process knowledge and organize scientific and technological phenomena in various ways.**

- Describe materials using quantitative and qualitative skills based on observations **See Paint 21-31, 36; 43; Pulp 13-24; Carbonated passim; Drug 61; Lab 9-11; Petroleum 1-3**
 - Develop appropriate scientific experiments: raising questions, formulating hypotheses, testing, controlled experiments, recognizing variable, manipulating variable, interpreting data, and producing solutions. **See, for instance, Carbonated Beverage, 11-17, 21-23, 25-27; Petroleum 1-3, 48; Forensic 35-45; Wastewater 4,5, 43-45**
- C. Apply the elements of scientific inquiry to solve problems.**
- Generate questions about objects, organisms and/or events that that be answered through scientific investigations. **See, for instance, Carbonated 11-13, 14-17, 21-23, 25-27; Wastewater 45-47, Drugs 36, Forensic 37-42; Semiconductors 12, 16, 19; Lab 36; Drugs 24**
 - Evaluate the appropriateness of questions
 - Design an investigation with adequate control and limited variables to investigate a question. **See, for instance, Carbonated 11-13, 14-17, 21-23, 25-27; Drugs 36-37, 40, 46; Lab 21, 24, 25; Pulp 17, 19, 41**
 - Conduct a multiple step experiment. **See, for instance, Carbonated 11-19; Wastewater 43-53; Plant 16-36; Pulp 8-24; Wastewater 14-24**
 - Organize experimental information using a variety of analytic methods. **See, for instance, Carbonated 53-54; Pulp 8-9; Plant 9-11; Drugs 14-15**
 - Judge the significance of experimental information in answering the question **See for instance, Carbonated 13, 15, 22, 26, 34-35, etc; Forensic 43, 36, 32; Wastewater 44; Drugs 34, 36**
 - Suggest additional steps that might be done experimentally **See “Connecting to the Problem, “ for instance Carbonated 37-38; Polymer 51; Pulp 42; Petroleum 34; Forensics 34; Semiconductors 13, 16, 19, 25**
- D. Identify and apply the technological design process to solve problems.**
- Examine the problem, rank all necessary information and all questions that must be answered **See STW generally**
 - Propose and analyze a solution **See STW generally**
 - Implement the solution **See STW generally**
 - Evaluate the solution, test, redesign and improve as necessary **See STW generally**
 - Communicate the process and evaluate and present the impacts of the solution **See STW generally**

Grade 12

- A. Evaluate the nature of scientific and technological knowledge**
- Know and use the ongoing scientific process to continually improve and better understand how things work. **See, for example, Polymer passim; Carbonated Passim; Wastewater Passim; Drugs Passim; Lab Passim**
- B. Evaluate experimental information for appropriateness and adherence to relevant science processes.**
- Judge that conclusions are consistent and logical with experimental conditions. **See, for instance, Polymer, “Arriving at Conclusions,” 29; Semiconductors 25, 30, 35; Drugs 18, 24; Good 14, 16, 28**
 - Interpret results of experimental research to predict new information or improve a solutions **See, for instance, Polymer, “Connecting to the Problem,” 19; Food 28, 35; Pulp 21-22, 36-37; Wastewater 12; Petroleum 34, 41, 45; Lab 50, 27, 33**
- C. Apply the elements of scientific inquiry to solve multi-step problems**
- Generate questions about objects, organisms and/or events that that be answered through scientific investigations. **See, for instance, Carbonated 11-13, 14-17, 21-23, 25-27; Wastewater 12-13, 20-23; Drugs 44; Lab 38, 40**
 - Evaluate the appropriateness of questions **See, for instance, Carbonated 11-13, 14-17, 21-23, 25-27; Forensics 52, 55, 34; Lab 43-44, Pulp 17-18**
 - Design an investigation with adequate control and limited variables to investigate a question. **Wastewater 43-7; Petroleum 25-26; Polymer 31-35**
 - Conduct a multiple step experiment. **See, for instance, Carbonated 11-19; Drugs 13-16; Lab 21-27; Forensics 12-21; Semiconductors 6-8**
 - Organize experimental information using a variety of analytic methods. **See, for instance, Carbonated 53-54; Semiconductors 37; Forensics 37-38; Lab 43; Drugs 37-38**
 - Evaluate the significance of experimental information in answering the question **See “Connecting to the Problem,” for instance Pulp 21-22; Drugs 38, 45; Plant 27-29; Carbonated 23, 30**
 - Project additional questions from a research study that could be studied. **See “Connecting to the Problem,” for instance Pulp 21-22; Carbonated 35; Polymer 48, 51; Lab 9; Drugs 22, 52**

- D. Analyze and use the technological design process to solve problems**
- Assess all aspects of the problem, prioritize the necessary information, and formulate questions that must be answered. **See STE generally**
 - Propose, develop, and appraise the best solution and develop alternative solutions. **See STW generally**
 - Implement and assess the solution **See STW generally**
 - Evaluate and assess the solution, redesign and improve as necessary. **See STW generally**
 - Communicate and assess the process and evaluate and present the impacts of the solution. **See, for instance, Polymer 61-63; Food 29, 48-49; Drugs 5, 8; Wastewater 52, 74-75**

3.3 Biological Sciences

Grade 10

- C. Describe how gene formation is inherited and expressed**
- Compare and contrast mitosis function and process. **Plant 23-29**
 - Distinguish different reproductive patterns in living things (e.g., budding, spores, fission) **Plant 15-15**
 - Compare random and selective breeding practices and their results (e.g., antibiotic resistant bacteria). **Plant 15-29.**
 - Explain the relationship among DNA, genes, and chromosomes. **(Plant 18-22)**

Grade 12

- D. Explain gene expression and inheritance at the molecular level.**
- Explain genetic engineering techniques, applications, and results. **Plant 15-29**

3.4 Physical Science, Chemistry and Physics

Grade 10

- A. Explain concepts about the structure and properties of matter:**
- Explain the formation of compounds and their resulting properties using bonding theories (ionic and covalent). **Carbonated 23; Polymer 17; Pulp 3; Drugs 37, 46, 51**
 - Recognize formulas for simple inorganic compounds. **Carbonated 24; Drugs 37-46, 51; Plant 22; Pulp 3, 17**
 - Apply knowledge of mixtures to appropriate separation techniques. **Carbonated 17, 31-32; Food 15, 19, 33; Petroleum 7, 15**

- Understand that carbon can form several types of compounds **Pulp 3; Polymer 2-3, 17; Drugs 44; Petroleum 7, 42**

B. Analyze energy sources and transfers of heat

- Evaluate energy changes in chemical reactions. **Wastewater 15-25; Pulp 17; Petroleum 15, 28**

Grade 12

A. Apply concepts about the structure and properties of matter.

- Apply rules of systematic nomenclature and formula writing to chemical substances. **Carbonated 23, 24; Paint 22, 40, 41, 42, 67; Polymer 3, 17, 65; Pulp 3; Wastewater 18, 66; Petroleum 7, 10-15; Lab 10, 36-37, 40, 42-44**
- Explain how the forces that bind solids, liquids and gases affect their properties. **Polymer 17; Drugs 49, 53, 64; Forensics 23**
- Characterize and identify important classes of compounds (e.g., acids, bases, salts). **Carbonated 40-49; Pulp 3, Drugs 46, 51**

3.5 Earth Sciences

Grade 10

C. Assess the value of water as a resource

- Identify the components of a municipal/agricultural water supply system and a wastewater treatment system. **See Wastewater passim**
- Relate aquatic life to water conditions (e.g., turbidity, temperature, salinity, dissolved oxygen, nitrogen levels, pressure) **Wastewater 32-36, 43-48, 61-78**
- Assess the natural and man-made factors that affect the availability of clean water (e.g., rock and mineral deposits, man-made pollution) **Wastewater 1**

Grade 12

D. Analyze the principles and history of hydrology

- Analyze the operation and effectiveness of a water purification and desalination system. **See Wastewater passim**

3.6 Technology Education

Grade 10

A. Apply biotechnologies that relate to propagating, growing, maintaining, adapting, treating and converting

- Apply knowledge of plant and animal production processes in designing and improvement to existing processes. (See **Plant passim**); **Food 9, 18, 29**

Grade 12

A. Apply biotechnologies that relate to propagating, growing, maintaining, adapting, treating and converting

- Analyze and solve a complex production process problem using biotechnologies (e.g., hydroponics, fish farming, crop propagation) See **Plant passim; Wastewater 3; Carbonated 4-5; Lab Passim**
- Evaluate and apply biotechnical processes to complex plant and animal production methods. See **Plant passim; Food Passim**
- Apply knowledge of biochemical-related technologies to propose alternatives to hazardous waste treatment. See **Wastewater passim; Petroleum Passim**
- Analyze and apply complex skills needed to process materials in complex manufacturing enterprises. See **Polymer, esp. p. 58; Semiconductors 4-7, 14; Petroleum x-xi, 5-7**

3.7 Technological Devices

Grade 10

A. Identify and safely use a variety of tools, basic machines, materials and techniques to solve problems and answer questions

- Select and safely apply appropriate tools, materials and processes necessary to solve complex problems. See, for instance, **Carbonated xviii-xix; Plant 4-5; Forensics 28-35; Semiconductors 14, 27, 32, 34, 36, 45-46**

B. Apply appropriate instruments and apparatus to examine a variety of objects and processes.

- Describe and use appropriate instruments to gather and analyze data. See, for instance, **Carbonated 31-36, 41; Food 50, 55; Petroleum 33; Drugs x; Lab 12**

Grade 12

- A. Apply advanced tools, materials, and techniques to answer complex questions**
- Determine the safe use of complex tools and machines within their specifications **See Carbonated xviii-xix; Polymer x, 4; Paint 22; Wastewater 7, 24, 28, 39**
 - Select and safely apply appropriate tools, materials and processes necessary to solve complex problems that could result in more than one solution **See *Science in a Technical World* generally**
 - Evaluate and use technological resources to solve complex multi-step problems **See *Science in a Technical World* generally**

3.8 Science, Technology, and Human Endeavors

Grade 10

- A. Analyze the relationship between societal demands and scientific and technological enterprises**
- Identify past and current tradeoffs between increased production, environmental harm and social values (e.g., increased energy needs, power plants, automobiles) **Wastewater 1; Petroleum x, 1-3; Pain x, 22**
 - Assess the social impacts of a specific international environmental problem by designing a solution that applies the appropriate technologies and resources **See Wastewater passim; Petroleum Passim**
- B. Analyze how human ingenuity and technological resources satisfy specific human needs and improve the quality of life.**
- Identify several problems and opportunities that exist in your community, apply various problem-solving methods to design and evaluate possible solutions. **See Wastewater passim**
 - Analyze a recently invented item, describing the human need that prompted its invention and the current and potential social impacts Of the specific invention. **See Polymer passim; Drugs Passim; Semiconductor Passim**
- C. Evaluate possibilities consequences and impacts of scientific and technological solutions**
- Compare and contrast potential solutions to technological, social, economic and environmental problems. **See Wastewater generally; Petroleum generally**
 - Analyze the impacts on society of accepting or rejecting scientific and technological advances. **Plant 15-29; Food 47; Drugs 11, 53, 56; Semiconductors 14, 21**

Grade 12

- A. Synthesize and evaluate the interactions and constraints of science and technology on society**
- Evaluate technological developments that have changed the way humans do work and discuss their impacts (e.g., genetically engineered crops). **Plants 15-29; Petroleum 5-7; Forensics 35, 37-39; Drugs 7**
 - Evaluate socially proposed limitations of scientific research and technological application. **Plant 15-29; Lab generally**
- B. Apply the use of ingenuity and technological resources to solve specific Societal needs and improve the quality of life.**
- Apply appropriate tools, materials and processes to solve complex problems. **See Wastewater passim; Drugs Passim, Lab Passim; Food passim; Semiconductors passim**
 - Apply appropriate tools, materials, and processes to physical, informational, or biotechnological systems to identify and recommend solutions to international problems. **Plant 15-29; Semiconductors 21, 46**
- C. Evaluate the consequences and impacts of scientific and technological Solutions.**
- Propose solutions to specific scientific and technological applications, identifying possible financial considerations. **See Wastewater generally; Semiconductors Passim; Petroleum Passim**
 - Analyze scientific and technological solutions through the use of risk/benefit analysis. **See Wastewater generally; Food generally; Lab generally; Forensics generally**

Abbreviations Used

Carbonated=The Carbonated Beverage Industry

Paint=Paint Research and Development

Plant=The Plant Tissue Culture Industry

Polymer=Polymer Research and Development

Pulp=Pulp and Paper Research and Development

Wastewater=Upgrading the Wastewater Treatment Plant

Food=Food Safety

Petroleum=Refining Petroleum

Drugs= Discovering New Medicinal Drugs

Lab=Medicinal Lab Technology

Forensic=Forensic Science

Semiconductors=Making Semiconductors