Pennsylvania
Science, Technology & Engineering and Environmental Literacy & Sustainability Standards (STEEL)

Grades 6, 7, 8

Adopted 2022

Life Science 3.1

Structure and Function

A. Conduct an investigation to provide evidence that living things are made of cells, either one cell or many different numbers and types of cells. 3.1.6-8.A

B. Develop and use a model to describe the function of a cell as a whole and the ways that parts of cells contribute to the function. 3.1.6-8.B

C. Use arguments supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. 3.1.6-8.C

Growth and Development of Organisms

D. Use arguments based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants, respectively. 3.1.6-8.D

E. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. 3.1.6-8.E

Organization for Matter and Energy Flow in Organisms

F. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. 3.1.6-8.F

G. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. 3.1.6-8.G

Information Processing

H. Gather and synthesize information about how sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. 3.1.6-8.H

Interdependent Relationships in Ecosystems

I. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. 3.1.6-8.I

J. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. 3.1.6-8.J

Cycles of Matter and Energy Transfer in Ecosystems

K. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. 3.1.6-8.K

Ecosystem Dynamics, Functioning, and Resilience

L. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. 3.1.6-8.L

Social Interactions and Group Behavior

na1. Not applicable at this level. 3.1.6-8.NA1

Inheritance of Traits

M. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. 3.1.6-8.M

Variation of Traits

N. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. 3.1.6-8.N

Evidence of Common Ancestry and Diversity

O. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. 3.1.6-8.O

P. Apply scientific ideas to construct an explanation for anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. 3.1.6-8.P

Q. Analyze displays of pictorial data to compare patterns of similarities in anatomical structures across multiple species to identify relationships not evident in the fully formed anatomy. 3.1.6-8.Q

Natural Selection

R. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. 3.1.6-8.R

S. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. 3.1.6-8.S

Adaptation

T. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. 3.1.6-8.T

Biodiversity and Humans

U. Evaluate competing design solutions for maintaining biodiversity and ecosystem services. 3.1.6-8.U

Physical Science 3.2

Structure and Properties of Matter

A. Develop models to describe the atomic composition of simple molecules and extended structures. 3.2.6-8.A

B. Develop a model that predicts and describes changes in the particle motion, temperature, and state of a pure substance when thermal energy is added or removed. 3.2.6-8.B

Chemical Reactions

C. Gather and make sense of information to describe how synthetic materials come from natural resources and impact society. 3.2.6-8.C

D. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. 3.2.6-8.D

E. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. 3.2.6-8.E

F. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. 3.2.6-8.F

Nuclear Processes

na1. Not applicable at this level. 3.2.6-8.NA1

Forces and Motion

G. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. 3.2.6-8.G

H. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. 3.2.6-8.H

Types of Interactions

I. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. 3.2.6-8.I

J. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. 3.2.6-8.J

K. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. 3.2.6-8.K

Definitions of Energy

L. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass and speed of an object. 3.2.6-8.L

Conservation of Energy and Energy Transfer

M. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. 3.2.6-8.M

N. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. 3.2.6-8.N

O. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. 3.2.6-8.O

Relationship Between Energy and Forces

P. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. 3.2.6-8.P

Energy in Chemical Processes and Everyday Life

na2. Not applicable at this level. 3.2.6-8.NA2

Wave Properties

Q. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. 3.2.6-8.Q

Electromagnetic Radiation

R. Develop and use a model to describe how waves are reflected, absorbed, or transmitted through various materials. 3.2.6-8.R

Information Technologies and Instrumentation

S. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. 3.2.6-8.S

Earth and Space Science 3.3

The Universe and Its Stars

A. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. 3.3.6-8.A

B. Develop and use a model to describe the role of gravity in the motion within galaxies and the solar system. 3.3.6-8.B

Earth and the Solar System

C. Analyze and interpret data to determine scale properties of objects in the solar system. 3.3.6-8.C

The History of Planet Earth

D. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. 3.3.6-8.D

Earth Materials and Systems

E. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. 3.3.6-8.E

F. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. 3.3.6-8.F

Plate Tectonics and Large-Scale System Interactions

G. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions. 3.3.6-8.G

The Roles of Water in Earth's Surface Processes

H. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. 3.3.6-8.H

I. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. 3.3.6-8.I

Weather and Climate

J. Collect data to provide evidence for how the motion and complex interactions of air masses result in changes in weather conditions. 3.3.6-8.J

O. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. 3.3.6-8.O

Biogeology

na1. Not applicable at this level. 3.3.6-8.NA1

Natural Resources

K. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. 3.3.6-8.K

Natural Hazards

L. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. 3.3.6-8.L

Human Impact on Earth Systems

M. Apply scientific principles to design a method for monitoring and minimizing human impact on the environment. 3.3.6-8.M

N. Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems. 3.3.6-8.N

Environmental Literacy & Sustainability 3.4

Agricultural Systems

A. Develop a model to describe how agricultural and food systems function, including the sustainable use of natural resources and the production, processing, and management of food, fiber, and energy. 3.4.6-8.A

Environment and Society

B. Analyze and interpret data about how different societies (economic and social systems) and cultures use and manage natural resources differently. 3.4.6-8.B

Watersheds and Wetlands

C. Develop a model to describe how watersheds and wetlands function as systems, including the roles and functions they serve. 3.4.6-8.C

Investigating Environmental Issues

D. Gather, read, and synthesize information from multiple sources to investigate how Pennsylvania environmental issues affect Pennsylvania's human and natural systems. 3.4.6-8.D

Environmental Experiences

E. Collect, analyze, and interpret environmental data to describe a local environment. 3.4.6-8.E

Evaluating Solutions

F. Obtain and communicate information on how integrated pest management could improve indoor and outdoor environments. 3.4.6-8.F

Environmental Sustainability

G. Obtain and communicate information to describe how best resource management practices and environmental laws are designed to achieve environmental sustainability. 3.4.6-8.G

Environmental Stewardship

H. Design a solution to an environmental issue in which individuals and societies can engage as stewards of the environment. 3.4.6-8.H

Environmental Justice

I. Construct an explanation that describes regional environmental conditions and their implications on environmental justice and social equity. 3.4.6-8.I

Technology & Engineering 3.5

Applying, Maintaining, and Assessing Technological Products and Systems

A. Research information from various sources to use and maintain technological products or systems. 3.5.6-8.A

B. Use instruments to gather data on the performance of everyday products. 3.5.6-8.B

C. Hypothesize what alternative outcomes (individual, cultural, and/or environmental) might have resulted had a different technological solution been selected. 3.5.6-8.C

D. Analyze how the creation and use of technologies consumes renewable, non-renewable, and inexhaustible resources; creates waste; and may contribute to environmental challenges. 3.5.6-8.D

E. Consider the impacts of a proposed or existing technology and devise strategies for reducing, reusing, and recycling waste caused by its creation. 3.5.6-8.E

F. Analyze examples of technologies that have changed the way people think, interact, live, and communicate. 3.5.6-8.F

G. Analyze how an invention or innovation was influenced by the context and circumstances in which it is developed. 3.5.6-8.G

H. Evaluate trade-offs based on various perspectives as part of a decision process that recognizes the need for careful compromises among competing factors. 3.5.6-8.H

I. Examine the ways that technology can have both positive and negative effects at the same time. 3.5.6-8.I

J. Use tools, materials, and machines to safely diagnose, adjust, and repair systems. 3.5.6-8.J

K. Use devices to control technological systems. 3.5.6-8.K

L. Design methods to gather data about technological systems. 3.5.6-8.L

M. (ETS) Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. 3.5.6-8.M

N. (ETS) Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. 3.5.6-8.N

O. Interpret the accuracy of information collected. 3.5.6-8.O

P. (ETS) Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. 3.5.6-8.P

Design and Design Thinking in Technology and Engineering Education

Q. Apply a technology and engineering design thinking process. 3.5.6-8.Q

R. Develop innovative products and systems that solve problems and extend capabilities based on individual or collective needs and wants. 3.5.6-8.R

S. Illustrate the benefits and opportunities associated with different approaches to design. 3.5.6-8.S

T. Create solutions to problems by identifying and applying human factors in design. 3.5.6-8.T

U. Evaluate and assess the strengths and weaknesses of various design solutions given established principles and elements of design. 3.5.6-8.U

V. Refine design solutions to address criteria and constraints. 3.5.6-8.V

W. (ETS) Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. 3.5.6-8.W

X. Defend decisions related to a design problem. 3.5.6-8.X

Integration of Knowledge, Technologies, and Practices

Y. Compare, contrast, and identify overlap between the contributions of science, technology, engineering, and mathematics in the development of technological systems. 3.5.6-8.Y

Z. Analyze how different technological systems often interact with economic, environmental, and social systems. 3.5.6-8.Z

AA. Adapt and apply an existing product, system, or process to solve a problem in a different setting. 3.5.6-8.AA

BB. Demonstrate how knowledge gained from other content areas affects the development of technological products and systems. 3.5.6-8.BB

Nature and Characteristics of Technology and Engineering

CC. Consider historical factors that have contributed to the development of technologies and human progress. 3.5.6-8.CC

DD. Engage in a research and development process to simulate how inventions and innovations have evolved through systematic tests and refinements. 3.5.6-8.DD

EE. Differentiate between inputs, processes, outputs, and feedback in technological systems. 3.5.6-8.EE

FF. Demonstrate how systems thinking involves considering relationships between every part, as well as how the systems interact with the environment in which it is used. 3.5.6-8.FF

GG. Create an open-loop system that has no feedback path and requires human intervention. 3.5.6-8.GG

HH. Create a closed-loop system that has a feedback path and requires no human intervention. 3.5.6-8.HH

II. Predict outcomes of a future product or system at the beginning of the design process. 3.5.6-8.II

JJ. Apply informed problem-solving strategies to the improvement of existing devices or processes or the development of new approaches. 3.5.6-8.JJ

KK. Explain how technology and engineering are closely linked to creativity, which can result in both intended and unintended innovations. 3.5.6-8.KK

LL. Compare how different technologies involve different sets of processes. 3.5.6-8.LL