6th Grade Science & Engineering Learning Expectations
Public Schools of Brookline

Overview

The Science & Engineering Learning Expectations (LEs) outline the content that students will learn and skills (practices) that students will be able to do from preK through Grade 8. They have been designed with careful consideration to how students will build their knowledge from grade to grade (learning progressions). As they progress through the grades, students will reinforce what they have learned before, continually learning certain overarching concepts in new ways and with increased sophistication.

Organization of the Learning Expectations

The Learning Expectations are organized into three strands: 1) Earth Science, 2) Life Science, and 3) Physical Science.

While the traditional Physical Science, Life Science, and Earth Science strands are referenced, it is important to be aware that none of these strands are totally separate. In fact, scientists often work in inter-disciplinary teams, across disciplines and/or alongside engineers to answer their questions and solve problems.

In addition, Science Practices (Inquiry and Nature of Science), Engineering and Environmental Education content has been woven throughout the Learning Expectations, illustrating the vital interconnections between these topics. This approach allows students to learn about these disciplines in the context of the science concepts they are learning, instead of as stand-alone, disconnected units.

Guide to This Document

This document shows the progression of Science concepts in the form of Big Ideas (left column) and Learning Expectations (right column). The Big Ideas identify the content that students will learn and the Learning Expectations illustrate what students will know and be able to do in order demonstrate that they have acquired this knowledge.

6th Grade Earth Science Learning Expectations [Water Unit]

EARTH'S SYSTEMS	
Big Ideas	**Learning Expectations**
Roles of Water on Earth: Water Cycle & Earth's Changing Surface • Earth's surface processes are the result of energy flowing and matter cycling within and among the planet's surface systems. This energy is derived from electromagnetic radiation from the sun. This flow of energy and cycling of matter produce chemical and physical changes in Earth's surface materials and living organisms. • There is a finite amount of water on Earth that is continually cycled among the land, ocean and atmosphere via transpiration, evaporation, condensation, precipitation and the downhill runoff on land. Global movements of water and changes in its chemical phase are driven by sunlight and gravity. • Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. • The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. • Water's movements both on the land and underground cause weathering and erosion, which change the land's surface features and create underground formations. • Rivers and glacial ice carry off soil and break down rock, eventually depositing the material in sediments or carrying it in solution to the sea. • The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. • Earth's water is part of the whole Earth system; what affects one part can affect the whole.	• Using maps and photographs, identify local landforms that were formed by water and ice. Explain how they were formed over time. • Model multiple pathways for the cycling of water through the atmosphere, geosphere and hydrosphere as it changes phase and moves in response to energy from the sun and the force of gravity. • Plan and conduct investigations to explain how temperature and salinity cause the separation and movement of water masses within the ocean. • Collect data to investigate the variables that affect how water causes the erosion, transportation, and deposition of surface and subsurface Earth materials. • Apply scientific knowledge to design engineered solutions to natural hazards (e.g., flooding, mass wasting) that result from surface geologic and hydrologic processes. • Illustrate and describe how water moves within the Charles River Watershed, pointing out parts of the watershed that exist in Brookline on a map.
Weather & Climate –Connection to Biomes [Social Studies] • Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. • The ocean and land exert major influences on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it via	• Gather evidence and make claims about how the interactions among solar radiation, water (e.g., the ocean, lakes, wetlands), ice, landforms, and the biosphere influence repeating weather patterns of temperature, precipitation, and air pressure at geographic locations. • Using models, explain how the movements and patterns of atmospheric and oceanic circulation are influenced by latitude, altitude, and local and regional geography.

oceanic and atmospheric circulation. The patterns of differential heating, together with Earth's rotation and configuration of continents and oceans, control the large-scale patterns of oceanic and atmospheric circulation.	• Use representations to explain how the patterns of atmospheric and oceanic circulation (e.g., Hadley cells, jet stream, Gulf Stream) impact local climates (e.g., locations of rainforests and deserts).
Human Interactions with Earth [Social Studies Connections] • Fresh water, limited in supply, is essential for life and also for most industrial processes. • Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Fresh water and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of weather- and climate-related processes. • Humans have become one of the most significant agents of change in the near-surface Earth system. Human activities have significantly altered the biosphere, geosphere, hydrosphere and atmosphere. • As human populations and per-capita consumption of natural resources increase, so do the impacts on Earth's systems unless the activities and technologies involved are engineering otherwise. • Continued monitoring of the changes to Earth's surface provides a deeper understanding of the way in which human activities are impacting Earth's systems, providing the basis for social policies and regulations that can reduce these impacts. • Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature ("global warming"). • Reducing the amount of greenhouse gases released into the atmosphere can reduce the degree to which global temperatures will increase. • Renewable energy resources and the technologies to exploit them are being rapidly developed.	• Analyze patterns in the distribution of fresh water and biosphere resources in order to construct arguments for the best uses of those resources, taking into account the natural constraints on their availability. • Use system models and representations to explain how human activities significantly impact the hydrosphere. • Generate and revise explanations from data for the impacts on Earth's hydrosphere that result from increases in human population and rates of consumption. • Ask questions and define problems about the way continued technological monitoring of Earth's systems can provide the means of informing social policies and regulations that will reduce human impacts on Earth's systems. • Use arguments and empirical evidence to evaluate technologies that responsibly exploit renewable energy resources. • Explain ways in which humans and their activities have affected water within the Charles River Watershed. Explain how these impacts been reduced over time. • Describe the types of projects have been completed and/or are underway to clean our local water sources (e.g., Muddy River Restoration). • Explain where we get our drinking water from in Brookline and where our wastewater goes (and how it is treated). • Design technological and engineering solutions for stabilizing changes to communities by using water efficiently and minimizing human impacts on the hydrosphere. • Explain the challenges that people throughout the world encounter to ensure that they have a reliable supply of clean water. Describe innovative technologies and programs that are being developed to help make these situations better.

6th Grade Life Science Learning Expectations [Water Unit and Nervous System Unit]

Big Ideas	Learning Expectations
Ecosystems • Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors. Growth of organisms and population increases are limited by access to resources. • In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. • Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. • Mutually beneficial interactions, on the other hand, may become so interdependent that each organism requires the other for survival. While the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. • Food webs are models that demonstrate how matter and energy is transferred between producers (generally plants and other organisms that engage in photosynthesis), consumers, and decomposers as the three groups interact—primarily for food—within an ecosystem. • Animals (including us) get energy indirectly, eating plants and/or other animals to get the food they need. • Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.	• Construct and communicate models to investigate the effect of resource availability on the populations of organisms in an environment. Explain how the annual temperature and rainfall patterns affect the amount of resources/energy available to support life. • Analyze data to determine the patterns of interactions across multiple ecosystems that demonstrate competitive, predatory and/or mutually beneficial relationships among organisms. • Create and explain models of food webs that demonstrate the transfer of matter and energy between organisms (producers, consumers, and decomposers) within an ecosystem. • Ask researchable questions about the ways organisms obtain matter and energy across multiple and varied ecosystems. Pursue answers to these questions using credible sources, make claims based on this evidence, and share with others either verbally or in written form. • Engage in arguments from evidence that changing any physical or biological component of an ecosystem results in shifts in populations. • Study and analyze solutions to achieve sustainable ecosystems near cities, towns and/or farms. • Create a model of an ecosystem, explaining how the different living and nonliving components interact with one another. • Use evidence from credible sources to support arguments that changing a physical or biological component of an ecosystem affects the species that live there. • Use data to make claims about the effect of predation and mutually beneficial interactions on populations. • Given a scenario, predict the consequences of human activity on a local ecosystem.
Nervous System [Health Connection] • In complex animals, the brain is divided into several distinct regions and circuits, each of which primarily serves dedicated functions, such as visual perception, auditory perception, interpretation of perceptual information, guidance of motor movement, and decision making about actions to take in the event of certain	• Explain, using examples, how sense receptors respond to stimuli. • Provide evidence to show how the storage of long-term memories requires changes in the structure and function of millions of interconnected nerve cells in the brain. Explain how we know this.

inputs. In addition, some circuits give rise to emotions and memories. The integrated functioning of all parts of the brain is important for successful interpretation of inputs and generation of behaviors in response to them. • The brain never stops growing and changing over our lifetimes. • The nervous system receives information about what is happening both inside and outside the body. It also directs the way in which the body responds, voluntarily or autonomically. • The central nervous system is the control center that receives and sends messages to other parts of the body. • The senses bring information about the environment into the body and change the information into nerve impulses. Inputs change the structure of the brain. • The nervous system has adapted different traits in various species to help them survive in their environment • Many substances affect the nervous system—some have negative effects. • There are things we can do to protect our brain and keep it healthy • Although there is still much to learn, scientific research continues to improve our understanding of the processes within the nervous system.	• Illustrate and explain the functions of the major parts of the brain and how they impact our daily lives. • Make a model or representation that explains the function and processes involved in the nervous system. Describe how the nervous system is vital for our survival, and explain how it works together as a system with other body systems. • Explain various learning styles and list strategies students can use to optimize their learning. • Compare and contrast nervous system structures from different types of organisms (such as jellyfish, worms and humans). • Describe the historical development of neuroscience and give examples of how and why scientific ideas in neuroscience have changed over time.

6th Grade Physical Science Learning Expectations [Water Unit]

MATTER

Big Ideas	Learning Expectations
Properties of Matter • Temperature is not a measure of energy; the relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. • Water is the only matter that is naturally abundant as a solid, a liquid and a gas. • Water has many unique properties that affect both living features and the surface of the Earth (e.g., cohesion, adhesion, surface tension, capillary action, density, salinity, expands when frozen, etc.). • Water is the universal solvent. This property has implications for weathering and pollution.	• Gather evidence to make claims about the effect of adding or removing thermal energy to a substance in various phases and during a phase change. • Illustrate how the following properties of water result in the movement of water such as ocean currents: density, equilibrium (add hot water to cold water—when do they reach equilibrium?), buoyancy, floating, displacement [iceberg breaks off, compare iceberg with oil tanker of same size] • Create models to show phase change in water (evaporation, condensation). • Compare and contrast the characteristics of fresh water and salt water (buoyancy, density, etc.). • Demonstrate that some substances dissolve in water and some do not.

ENERGY

Big Ideas	Learning Expectations
Energy Transfer • Oceans are a key factor in energy transfer through the Earth system. • Water has a high capacity for storing energy from the Sun (high specific heat). • Due to water's high specific heat and the fact that oceans cover 70% of Earth's surface, water has a strong effect on weather and climate.	• Explain why water in the oceans drives energy transfer in the Earth system. • Make a model to illustrate how energy is transferred through Earth's hydrosphere.