

Simple Solutions

NextGen Science 8

Alignment with DCIs

MS PHYSICAL SCIENCE

PS3.A Definitions of Energy

- ✦ Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
 - Lessons 1, 2, 3, 4

PS4.A Wave Properties

- ✦ A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
 - Lessons 6, 7, 8

MS EARTH SCIENCE

ESS1.C The History of Planet Earth

- ✦ The geologic time scale interpreted from rock strata provides a way to organize Earth’s history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.
 - Lesson 59
- ✦ Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. (HS.ESS1.C GBE), (secondary)
 - Lessons 59, 61, 62, 63, 69

ESS2.A Earth’s Materials and Systems

- ✦ The planet’s systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth’s history and will determine its future.
 - Lessons 58, 62, 78
- ✦ All Earth processes are the result of energy flowing and matter cycling within and among the planet’s systems. This energy is derived from the sun and Earth’s hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth’s materials and living organisms.
 - Lessons 62, 63, 64, 66, 67, 68

ESS2.B Plate Tectonics and Large-scale System Interactions

- ✦ Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth’s plates have moved great distances, collided, and spread apart.
 - Lessons 59, 61, 63, 64, 67, 68, 69

ESS2.C The Roles of Water in Earth’s Surface Processes

- ✦ Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.
 - Lessons 69, 104
- ✦ Global movements of water and its changes in form are propelled by sunlight and gravity.
 - Lessons 91, 104
- ✦ 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.
 - Lessons 87, 88, 89
- ✦ Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.
 - Lessons 91, 92
- ✦ Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations.
 - Lessons 71, 72, 73, 74, 76, 77, 78

ESS2.D Weather and Climate

- ✦ Because these patterns are so complex, weather can only be predicted probabilistically.
 - Lessons 98, 99
- ✦ 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.
 - Lessons 79, 81, 82, 83, 84, 86, 87, 88, 89, 93, 94, 96, 97
- ✦ 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.
 - Lessons 91, 92, 93

ESS3.A Natural Resources

- ✦ Humans depend on Earth’s land, ocean, atmosphere, and biosphere for many different resources. Minerals, 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 past geologic processes.
 - Lessons 101, 102, 103, 104, 106, 107, 108, 109, 111, 112, 113

ESS3.B Natural Hazards

- ✦ Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.
 - Lessons 68, 116, 117, 118, 119, 121, 122, 123, 124

ESS3.C Human Impacts on Earth Systems

- ✦ Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts (negative and positive) for different living things.
 - Lessons 43, 114, 126, 127, 128, 129, 131
- ✦ Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.
 - Lessons 101, 107, 109, 111, 112, 113, 114, 126, 127, 128, 129, 131

ESS3.D Global Climate Change

- ✦ 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 level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.
 - Lessons 126, 127, 128, 129, 131

MS LIFE SCIENCE

LS1.A Structure and Function

- ✦ All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)
 - Lessons 9, 11
- ✦ Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)
 - Lessons 12, 13, 14, 16, 17, 18, 19, 21
- ✦ In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)
 - Lessons 23, 24

LS1.B Growth and Development of Organisms

- ✦ Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (Secondary to MSLS3-2)
 - Lessons 16, 21, 22

LS1.D Information Processing

- ✦ Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8)
 - Lessons 23, 24, 26, 27

LS2.A Interdependent Relationships in Ecosystems

- ✦ Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)
 - Lessons 28, 29, 31
- ✦ Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)
 - Lesson 29
- ✦ Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although 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. (MS-LS2-2)
 - Lesson 34

LS2.C Ecosystem Dynamics, Functioning, and Resilience

- ✦ 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. (MS-LS2-4)
 - Lessons 31, 33, 34
- ✦ Biodiversity describes the variety of species found in Earth’s terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem’s biodiversity is often used as a measure of its health. (MS-LS2-5)
 - Lessons 32, 34

LS4.D Biodiversity and Humans

- ✦ Changes in biodiversity can influence humans’ resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (secondary to MS-LS2-5)
 - Lesson 36

LS3.A Inheritance of Traits

- ✦ Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)
 - Lessons 17, 18, 19, 21, 22, 41
- ✦ Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)
 - Lesson 41

LS3.B Variation of Traits

- ✦ In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)
 - Lessons 16, 17, 18, 19, 21, 22, 41

- ✦ In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)
 - Lessons 21, 22, 41

LS4.A Evidence of Common Ancestry and Diversity

- ✦ The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)
 - Lessons 44, 46, 47
- ✦ Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)
 - Lessons 46, 47, 48, 49, 51, 52
- ✦ Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)
 - Lesson 48

LS4.B Natural Selection

- ✦ Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)
 - Lesson 39
- ✦ In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4-5)
 - Lesson 38

LS4.C Adaptation

- ✦ Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)
 - Lessons 37, 42

MS. ENGINEERING DESIGN

ETS1.A Defining and Delimiting an Engineering Problem

- ✦ The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (secondary)
 - Lessons 53, 54, 56, 57, 106, 108

ETS1.B Developing Possible Solutions

- ✦ A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.
 - Lessons 53, 54, 56, 57, 106, 108
- ✦ There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary)
 - Lessons 53, 54, 56, 57, 106, 108

ETS1.C Optimizing the Design Solution

- ✦ Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process - that is, some of the characteristics may be incorporated into the new design. (secondary)
 - Lessons 53, 54, 56, 57, 106, 108
- ✦ The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (secondary)
 - Lessons 53, 54, 56, 57, 108

MS SCIENCE AND ENGINEERING PRACTICES

- Lessons 1, 2, 3, 4, 11, 34, 38, 48, 53, 54, 56, 57, 59, 98, 99, 101, 106, 108, 112, 114, 116, 117, 118, 119, 121, 122, 123, 124, 126, 127, 128, 129, 131

MS CROSSCUTTING CONCEPTS

- Lessons 1, 2, 3, 4, 11, 12, 13, 14, 16, 17, 18, 19, 21, 22, 29, 31, 33, 37, 38, 39, 49, 51, 52, 53, 54, 56, 57, 58, 59, 62, 63, 64, 66, 68, 69, 71, 72, 73, 74, 76, 81, 82, 83, 84, 86, 87, 88, 89, 91, 92, 93, 94, 96, 97, 101, 112, 114, 116, 117, 118, 119, 121, 122, 123, 124, 126, 127, 128, 129, 131