Simple Solutions

NextGen Science 7

Alignment with DCIs

MS.PHYSICAL SCIENCE

PS1.A Structures and Property of Matter

- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.
  - **Lessons 21, 109**
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).
  - **Lessons 21, 109**
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
  - **Lesson 71**

PS1.B Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.
  - **Lessons 22, 23, 24, 27, 28, 29, 31, 32**
- The total number of each type of atom is conserved, and thus the mass does not change.
  - **Lessons 22, 23**
- Some chemical reactions release energy, others store energy.
  - **Lessons 26, 27**

PS2.A Forces and Motion

- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.
  - **Lesson 1**

PS2.B Types of Interactions

- Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.
  - **Lessons 1, 2, 3, 4, 6**

- Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.
  - **Lessons 7, 8**
- Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).
  - **Lessons 1, 2, 3, 4, 6, 7, 8, 13, 14**

PS3.A Definitions of Energy

- The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects.
  - **Lesson 17**
- The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material.
  - **Lesson 16**
- 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.
  - **Lesson 9**
- A system of objects may also contain stored (potential) energy, depending on their relative positions.
  - **Lessons 9, 11, 12, 13, 14**
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.
  - **Lesson 16**

PS3.B Conservation of Energy and Energy Transfer

- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
  - **Lessons 11, 12, 13, 14**
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
  - **Lesson 17**

PS3.C Relationship Between Energy and Forces

- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.
  - **Lessons 11, 12, 13, 14**

PS4.A Wave Properties

- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
  - **Lessons 33, 34, 36**
- A sound wave needs a medium through which it is transmitted.
  - **Lessons 37, 38, 39, 41, 42**

PS4.B Electromagnetic Radiation

- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.
  - **Lessons 43, 44, 46, 48, 49, 51**
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.
  - **Lessons 48, 51, 52, 53, 54**
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.
  - **Lessons 44, 49, 51, 52**
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves.
  - **Lessons 43, 51**

PS4.C Information Technologies and Instrumentation

- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.
  - **Lessons 56, 57, 58, 59, 61, 62, 63, 64**

MS EARTH SCIENCE

ESS2.A Earth's Materials and Systems

- 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 109, 111, 112, 113, 114**

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 116, 117, 118,**

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 66, 68, 79, 81**
- 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 67, 69, 72, 73, 74, 76, 77, 78, 79, 81**
- 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 82, 83, 84, 86, 87**

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)
  - **Lesson 98**
- Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4)
  - **Lesson 104**
- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4)
  - **Lessons 106, 107**
- Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)
  - **Lesson 108**

LS1.C: Organization for Matter and Energy Flow in Organisms

- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)
  - **Lessons 88, 92, 97**
- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)
  - **Lessons 89, 91**

PS3.D: Energy in Chemical Processes and Everyday Life

- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to MS-LS1-6)
  - **Lessons 88, 92, 97**

- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)
  - **Lessons 89, 91, 97**

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems

- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)
  - **Lessons 92, 93, 94, 96, 97**

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 74, 99, 101**
- 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)
  - **Lessons 99, 101**

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 99, 101**

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 18, 19**

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 18, 19**

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 18, 19**
- 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 18, 19**

MS SCIENCE AND ENGINEERING PRACTICES

- **Lessons 27, 28, 29, 31, 32, 68, 74, 99, 101, 102, 103**

MS CROSSCUTTING CONCEPTS

- **Lessons 2, 7, 9, 11, 12, 13, 14, 17, 18, 19, 23, 26, 27, 28, 29, 31, 32, 34, 36, 41, 42, 46, 47, 63, 64, 67, 68, 69, 72, 73, 74, 76, 77, 78, 79, 81, 82, 83, 84, 86, 87, 88, 89, 91, 93, 94, 96, 97, 99, 101, 102, 103, 108, 109, 111, 112, 113, 114, 116, 117, 118, 119**