Simple Solutions

NextGen Science 6

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.
  - **Lesson 28**
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).
  - **Lessons 28, 29**
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.
  - **Lessons 33, 34, 36, 37**
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.
  - **Lesson 31**
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.
  - **Lessons 31, 32**
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.
  - **Lessons 49, 51, 52, 53, 54**

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 56, 57, 58**
- The total number of each type of atom is conserved, and thus the mass does not change.
  - **Lesson 58**

PS2.A Forces and Motion

- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).
  - **Lesson 26**

- 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.
  - **Lessons 11, 18, 21, 22, 23, 24**
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.
  - **Lesson 19**

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 14, 16, 17**
- 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 82, 83**
- 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 12, 13**

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.
  - **Lessons 44, 46**
- 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 43**
- 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 38, 39**
- A system of objects may also contain stored (potential) energy, depending on their relative positions.
  - **Lessons 38, 40**

- 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 43**

PS3.B Conservation of Energy and Energy Transfer

- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
  - **Lesson 44**
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.
  - **Lessons 46, 47, 48**
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
  - **Lesson 42**

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 41, 42**

MS EARTH SCIENCE

ESS1.A The Universe and its Stars

- Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.
  - **Lessons 61, 62, 64, 66, 67**
- Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.
  - **Lessons 78,79, 81**

ESS1.B Earth and the Solar System

- This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year.
  - **Lessons 61, 63, 68, 69, 71, 72, 73, 74, 76, 77**
- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.
  - **Lessons 59, 82, 83, 88, 89, 91, 92, 93, 94, 96, 97, 98, 99, 103, 104**
- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.
  - **Lessons 84, 86, 87, 88, 93**

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.
  - **Lessons 106, 107, 108, 109, 111, 112, 113, 114, 116, 117, 118, 119**

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.
  - **Lesson 119**
- 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.
  - **Lesson 119**

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)
  - **Lesson 121**

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 122, 123**
- Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)
  - **Lesson 124**
- 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 126**

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 127, 128, 129**

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)
  - **Lesson 27**

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.
  - **Lesson 27**

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)
  - **Lesson 27**

MS SCIENCE AND ENGINEERING PRACTICES

- **Lessons 1, 2, 3, 4, 6, 7, 8, 9, 99, 101, 102, 107, 108, 118**

MS CROSSCUTTING CONCEPTS

- **Lessons 14, 16, 17, 18, 21, 22, 23, 26, 27, 28, 29, 31, 36, 37, 38, 41, 42, 44, 47, 49, 51, 52, 54, 57, 58, 61, 62, 64, 66, 67, 69, 74, 76, 77, 78, 83, 86, 93, 99, 101, 102, 103, 104, 106, 107, 108, 109, 112, 113, 114, 117, 118, 119, 124, 126, 127, 128, 129**