GRADES 6-8

Overview

Middle school students can be characterized as curious, energetic, and enthusiastic. These students are moving from childhood to adolescence at various rates. They possess multiple learning styles, varied intellectual abilities, and are sensitive to peer perception. Teachers are challenged to incorporate effective classroom strategies that meet students' growing needs as individual learners while helping students make the transition from learning concrete facts to making scientific applications. With a foundation based on inquiry, the middle school science curriculum affords students opportunities for exploration and an in-depth study of science concepts. The scientific process and application skills located on page 10 of this document should be integrated into the teaching of the required science content.

Earth and Space Science, Life Science, and Physical Science content and skills are best taught through a "hands-on," "minds-on" approach to learning. In order to facilitate this process, the science classroom must extend beyond traditional boundaries while maintaining a primary focus on student safety. Students learn the "what" while being encouraged to seek the "why" and "how" behind natural phenomena. By designing a challenging curriculum, creating a supportive environment, stimulating student imagination, and providing opportunities for investigation, science teachers enable students to become actively involved in their own learning.

Success in science translates into the creation of productive, lifelong learners capable of meeting the needs and challenges of the twenty-first century. The goals of the middle school science program, therefore, are to meet the needs of the individual learner, to challenge all students to excel, and to provide students with the resources necessary to acquire science content and skills applicable both within and beyond the educational setting.

SIXTH GRADE

Earth and Space Science

Sixth-grade students are energetic and curious. They are maturing at a rapid rate and are in a transitional stage characterized by physical, social, and cognitive changes. The sixth-grade classroom environment addresses these changes by providing balance between elementary and middle school practices. While these changes lead students toward emotional and academic independence, sixth-graders continue to need guidance. They also need an environment that both supports and challenges them as they become more responsible individuals.

The curriculum for Grade 6 focuses on Earth and Space Science. As sixth-grade students become more aware of their environment, their natural curiosity about this important field of study is easily stimulated. Content standards challenge students to discover their world, their planet, and Earth's place in the universe. Students are provided opportunities to learn important scientific facts and to build conceptual understanding of scientific principles, laws, and theories. Their study is inquiry-based, allowing them to develop critical-thinking skills and problem-solving abilities needed for future studies in the field of science.

Students will:

1. Identify global patterns of atmospheric movement, including El Niño, the Gulf Stream, the jet stream, the Coriolis effect, and global winds that influence local weather.
    - Predicting local weather and weather patterns
        Examples: cold and warm fronts, high and low pressure areas
    - Describing the function of instruments and technology used to investigate Earth's weather, including barometers, thermometers, wind socks, weather vanes, satellites, radar, weather balloons, and rain gauges
    - Using lines of latitude and longitude to locate areas of specific weather events
    - Interpreting weather data through observations collected over time
        Example: calculating annual precipitation and average temperature

2. Describe factors that cause changes to Earth's surface over time.
    Examples: earthquakes, volcanoes, weathering, erosion, glacial erosion or scouring, deposition, water flow, tornadoes, hurricanes, farming and conservation, mining and reclamation, deforestation and reforestation, waste disposal, global climate changes, greenhouse gases

    - Comparing constructive and destructive natural processes and their effects on land formations
        Examples: constructive—volcanic and mountain-building processes; destructive—erosion by wind, water, and ice
    - Distinguishing rock strata by geologic composition
        Examples: predicting relative age of strata by fossil depth, predicting occurrence of natural events by rock composition in a particular strata

3. Describe water and carbon biogeochemical cycles and their effects on Earth.

4. Explain the plate tectonic theory.
   Example: using terminology such as *continental drift, seafloor spreading, lava, magma, eruption, epicenter, focus, seismic wave*, and *subduction zone*

   - Describing types of volcanoes and faults
   - Determining energy release through seismographic data
     Example: using data from the Mercalli scale and the Richter scale

5. Describe layers of the oceanic hydrosphere, including the pelagic zone, benthic zone, abyssal zone, and intertidal zone.

6. Describe regions of the oceanic lithosphere, including the continental shelf, continental slope, and abyssal plain.

7. Describe Earth's biomes.
   Examples: aquatic biomes, grasslands, deserts, chaparrals, taigas, tundras

   - Identifying geographic factors that cause diversity in flora and fauna, including elevation, location, and climate

8. Describe how Earth's rotation, Earth's axial tilt, and distance from the equator cause variations in the heating and cooling of various locations on Earth.

9. Identify the moon's phases.
   - Describing lunar and solar eclipses
   - Relating effects of the moon's positions on oceanic tides

10. Describe components of the universe and their relationships to each other, including stars, planets and their moons, solar systems, and galaxies.
    - Identifying the impact of space exploration on innovations in technology
      Examples: MRI, microwave, satellite imagery, GPS
    - Mapping seasonal changes in locations of constellations in the night sky
    - Describing the life cycle of a star
      Example: H-R diagram

11. Describe units used to measure distance in space, including astronomical units and light years.

SEVENTH GRADE

Life Science

Seventh-grade students experience a wide range of physical and psychological changes during this stage of development where peer perception and social interaction play major roles. As students seek to distance themselves from younger students, they must be encouraged to preserve the excitement of discovery while developing the self-discipline necessary for mastery of concepts at a higher level.

A variety of instructional strategies and techniques is essential for guiding students in Grade 7. Teachers must capitalize on the need for students to communicate and interact with classmates while harnessing their energy and enthusiasm for constructive learning activities. "Hands-on," "minds-on" learning by doing provides an excellent method of instruction for students at this stage as learning progresses from the concrete to the abstract and from knowledge to application in science.

The focus of the Life Science course allows seventh-grade students to connect the dynamics of the sixth-grade Earth and Space Science course with the rules that govern the known universe in the eighth-grade Physical Science course. As students' lives are affected daily by growth and experience, the curriculum for this age group provides the means for understanding the mechanisms behind maturity and development. Seventh-grade learners are ready to explore and question new ideas and theories. To preserve their natural curiosity and channel their focus on content, students in Grade 7 are encouraged to develop an appreciation for the importance of diversity of life while simultaneously understanding the impact their roles as individuals play in the community of life.

Students will:

1. Describe characteristics common to living things, including growth and development, reproduction, cellular organization, use of energy, exchange of gases, and response to the environment.
    - Identifying homeostasis as the process by which an organism responds to its internal or external environment
    - Predicting how an organism's behavior impacts the environment
    - Identifying unicellular organisms, including bacteria and protists, by their methods of locomotion, reproduction, ingestion, excretion, and effects on other organisms
    - Identifying the structure of a virus

2. Identify functions of organelles found in eukaryotic cells, including the nucleus, cell membrane, cell wall, mitochondria, chloroplasts, and vacuoles.
    Example: mitochondria releasing energy for use in cellular respiration

    - Identifying components of the cell theory
    - Identifying cells as prokaryotic or eukaryotic
    - Listing the sequence of the mitotic cell cycle

3. Relate major tissues and organs of the skeletal, circulatory, reproductive, muscular, respiratory, nervous, and digestive systems to their functions.
    - Arranging in order the organizational levels of the human body from the cell through organ systems

4. Describe organisms in the six-kingdom classification system by their characteristics.
    - Recognizing genus and species as components of a scientific name
    - Identifying contributions of Aristotle and Linnaeus to the early history of taxonomy

5. Identify major differences between plants and animals, including internal structures, external structures, methods of locomotion, methods of reproduction, and stages of development.
    - Describing the processes of photosynthesis and cellular respiration

6. Describe evidence of species variation due to climate, changing landforms, interspecies interaction, and genetic mutation.
    Examples: fossil records over geologic time, rapid bacterial mutations due to environmental pressures

7. Describe biotic and abiotic factors in the environment.
    Examples: biotic—plants, animals;
    abiotic—climate, water, soil

    - Classifying organisms as autotrophs or heterotrophs
    - Arranging the sequence of energy flow in an ecosystem through food webs, food chains, and energy pyramids

8. Describe the function of chromosomes.
    - Identifying genes as parts of chromosomes that carry genetic traits

9. Identify the process of chromosome reduction in the production of sperm and egg cells during meiosis.

10. Identify differences between deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).
    Examples: DNA—double helix, contains thymine;
    RNA—single stranded, contains uracil

    - Identifying Watson and Crick as scientists who discovered the shape of the DNA molecule

11. Identify Mendel's laws of genetics.
    - Recognizing Down's syndrome and sickle cell anemia as inherited genetic disorders
    - Using a monohybrid Punnett square to predict the probability of traits passed from parents to offspring

EIGHTH GRADE

Physical Science

Eighth-grade students exhibit a wide range of learning styles and intellectual abilities. This diverse range of development requires the implementation of a science curriculum that is designed to engage students in multiple types of scientific inquiry. The classroom environment must provide opportunities for questioning, exploration, and an in-depth study of important concepts. Curiosity and creativity flourish as teachers develop activities that encourage students to use their imaginations for solving problems and designing investigations. As in other disciplines, students engage in higher, more abstract thinking processes as they become well-grounded in experimental, manipulative, and laboratory-oriented processes. They also work in a variety of groups to foster collaboration among their peers.

Content standards in Grade 8 are inquiry-based and include concepts and skills in chemistry and physics that are considered foundational. This focus is designed to prepare students for the physics and chemistry courses that are often taken in high school. The scientific process and application skills should be integrated into the teaching of the required science content to allow students to combine reasoning and thinking skills with scientific knowledge. This Physical Science course provides eighth-grade students with a firm foundation for scientific literacy and for the pursuit of subsequent science courses.

Students will:

1. Identify steps within the scientific process.
    - Applying process skills to interpret data from graphs, tables, and charts
    - Identifying controls and variables in a scientific investigation
    - Measuring dimension, volume, and mass using *Système International d'Unités* (SI units)
    - Identifying examples of hypotheses
    - Identifying appropriate laboratory glassware, balances, time measuring equipment, and optical instruments used to conduct an investigation

2. Describe the structure of atoms, including the location of protons, neutrons, and electrons.
    - Identifying the charge of each subatomic particle
    - Identifying Democritus and Dalton as contributors to the atomic theory

3. Determine the number of protons, neutrons, and electrons, and the mass of an element using the periodic table.
    - Locating metals, nonmetals, metalloids, and noble gases on the periodic table
    - Using data about the number of electrons in the outer shell of an atom to determine its reactivity

4. State the law of conservation of matter.
    - Balancing chemical equations by adjusting coefficients

5. Differentiate between ionic and covalent bonds.
    - Illustrating the transfer or sharing of electrons using electron dot diagrams

6. Define solution in terms of solute and solvent.
    - Defining diffusion and osmosis
    - Defining isotonic, hypertonic, and hypotonic solutions
    - Describing acids and bases based on their hydrogen ion concentration

7. Describe states of matter based on kinetic energy of particles in matter.
    - Explaining effects of temperature, concentration, surface area, and catalysts on the rate of chemical reactions

8. Identify Newton's three laws of motion.
    - Defining terminology such as *action and reaction forces*, *inertia*, *acceleration*, *momentum*, and *friction*
    - Interpreting distance−time graphs

9. Describe how mechanical advantages of simple machines reduce the amount of force needed for work.
    - Describing the effect of force on pressure in fluids
        Example: increasing force on fluid leading to increase of pressure within a hydraulic cylinder

10. Differentiate between potential and kinetic energy.
    Examples: potential—rock resting at the top of a hill,
    kinetic—rock rolling down a hill

11. Explain the law of conservation of energy and its relationship to energy transformation, including chemical to electrical, chemical to heat, electrical to light, electrical to mechanical, and electrical to sound.

12. Classify waves as mechanical or electromagnetic.
    Examples: mechanical—earthquake waves;
    electromagnetic—ultraviolet light waves, visible light waves

    - Describing how earthquake waves, sound waves, water waves, and electromagnetic waves can be destructive or beneficial due to the transfer of energy
    - Describing longitudinal and transverse waves
    - Describing how waves travel through different media
    - Relating wavelength, frequency, and amplitude to energy
    - Describing the electromagnetic spectrum in terms of frequencies
        Example: electromagnetic spectrum in increasing frequencies—microwaves, infrared light, visible light, ultraviolet light, X rays