

Grades 7–8 Science Stems and Proficiencies

Earth and Space Science

ESS1 - The Earth and Earth materials, as we know them today, have developed over long periods of time, through constant change processes.

1. ATMOSPHERE, CLIMATE, & WEATHER

- 1) Identify and describe the processes involved in the water cycle and explain its effects on climatic patterns;
- 2) Identify and describe the impact certain factors have on the Earth's climate, including changes in the oceans' temperature, changes in the composition of the atmosphere, and geological shifts due to events, such as volcanic eruptions and glacial movements.

2. COMPOSITION & FEATURES OF EARTH MATERIALS

- 1) Describe the layers of the Earth, including the core, mantle, lithosphere, hydrosphere, and atmosphere;

2) *Use geological evidence provided to support the idea that Earth's crust/lithosphere is composed of plates that move.*

3. FOSSILS

- 1) Explain how fossils found in sedimentary rock can be used to support the theories of Earth's evolution over geologic time, and describe how the folding, breaking, and uplifting of the layers affects the evidence.

4. OBSERVATION OF EARTH FROM SPACE

- 1) Describe how catastrophic changes that have taken place on the Earth's surface can be revealed by satellite images.

5. PROCESSES AND RATES OF CHANGE OF THE EARTH'S SURFACE

- 1) Explain that the Earth's crust is divided into plates that move at extremely slow rates in response to movements in the mantle;

2) *Explain how earth events, abruptly and over time, can bring about changes in Earth's surface: landforms, ocean floor, rock features, or climate.*

3) *Explain the role of differential heating or convection in ocean currents, winds, weather and weather patterns, atmosphere, or climate.*

6. ROCK CYCLE

- 1) Describe the processes of the rock cycle.
- 2) Explain that sedimentary, igneous, and metamorphic rocks contain evidence of the minerals, temperatures, and forces that created them.
- 3) Explain how sediments of sand and smaller particles, which may contain the remains of organisms, are gradually buried and cemented together by dissolved minerals to form solid rock.

4) *Using data about a rock's physical characteristics make and support an inference about the rock's history and connection to the rock cycle.*

7. WATER AND THE EARTH'S SURFACE

- 1) Describe how water flows into and through a watershed, falling on the land, collecting in rivers and lakes, soil, and porous layers of rock, until much of it flows back into the ocean.

- 2) Identify the physical and chemical properties that make water an essential component of the Earth's system.

3) *Explain the processes that cause cycling of water into and out of the atmosphere and their connections to our planet's weather patterns.*

ESS2 - The Earth is part of a solar system, made up of distinct parts, which have temporal and spatial interrelationships.

1. EARTH, SUN AND MOON

- 1) Identify the characteristics of the Sun and its position in the universe.
- 2) Recognize the relationships between the tides and the phases of the moon, and use tide charts and NOAA information to describe them.
- 3) Recognize and describe how the regular and predictable motions of the Earth and Moon account for phenomena on Earth, including the day, the year, phases of the Moon, shadows, tides and eclipses.

4) *Explain the temporal or positional relationships between or among the Earth, Sun and Moon (e.g., night/day, seasons, year, tides).*

2. ENERGY

- 1) Describe the Sun as the principle energy source for phenomena on the Earth's surface.

3. SOLAR SYSTEM

- 1) Identify the characteristics and movement patterns of the planets in our Solar System and differentiate between them.
- 2) Explain the affects of gravitational force on the planets and their moons.
- 3) Explain why Earth and our Solar System appear to be somewhat unique, while acknowledging recent evidence that suggests similar systems exist in the universe;

4) *Compare and contrast planets based on data provided about size, composition, location, orbital movement, atmosphere, or surface features (includes moons).*

5) *Explain how gravitational force affects objects in the Solar System (e.g., moons, tides, orbits, satellites).*

4. VIEW FROM EARTH

1) *Explain how technological advances have allowed scientists to re-evaluate or extend existing ideas about the Solar System.*

ESS3 - The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time.

1. SIZE AND SCALE

- 1) Define an astronomical unit as the distance from the Earth to the Sun;
- 2) Explain that special units of measure, such as light years and astronomical units are used to calculate distances in space.

2. STARS AND GALAXIES

- 1) Describe objects such as asteroids, comets and meteors in terms of their characteristics and movement patterns.

3. UNIVERSE

- 1) Describe the universe as being comprised of billions of galaxies, each containing many billions of stars, and explain that there are vast distances separating these galaxies and stars from one another, and from the Earth.
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ESS4 – The growth of scientific knowledge in Earth Space Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand, and solve local and global issues.

1. DESIGN TECHNOLOGY

- 1) Describe ways in which technology has increased our understanding of the world in which we live.
- 2) Recognize the importance of technology as it relates to science, for purposes such as: access to space and other remote locations, sample collection and treatment, measurement, data collection, and storage, computation, and communication of information.

2. TOOLS

- 1) Calculate temperature in degrees Celsius;
- 2) Perform calculations using metric measurements;
- 3) Describe how man uses land based light telescopes, radio telescopes, satellites, manned exploration, probes and robots to collect data.

3. SOCIAL ISSUES (LOCAL AND GLOBAL)

USES OF EARTH MATERIALS

- 1) Provide examples of how creative thinking and economic need has shaped the way people use natural materials, such as the use of metal ores, petroleum, and fresh water.
- 2) Explain how to test natural materials to measure and compare their properties.

ENVIRONMENTAL CHANGE

- 1) Explain how technologies can reduce the environmental impact of natural disasters.
- 2) Identify the potential impact of converting forested land to uses such as farms, homes, factories, or tourist attractions.

4. CAREER TECHNICAL EDUCATION CONNECTIONS

- 1) Understand that some scientific jobs/careers involve the application of Earth Space science content knowledge and experience in specific ways that meet the goals of the job.
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Life Science

LS 1 – All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, & species).

1. CLASSIFICATION

- 1) Recognize that similarities among organisms are found in anatomical features and patterns of development, and explain how these can be used to infer the degree of relatedness among organisms.

2) *Describe or compare how different organisms have mechanisms that work in a coordinated way to obtain energy, grow, move, respond, provide defense, enable reproduction, or maintain internal balance (e.g., cells, tissues, organs and systems).*

2. LIVING THINGS AND ORGANIZATION

- 1) Identify the functions of the human body's systems, including digestion, respiration, reproduction, circulation, excretion, movement, control and coordination and protection from disease, and describe how they interact with one another.
- 2) Define a population and describe the factors that can affect it.
- 3) Explain why it is beneficial for an organism to be able to regulate its internal environment while living in a constantly changing external environment.

4) *Explain relationships between or among the structure and function of the cells, tissues, organs, and organ systems in an organism.*

5) *Using data and observations about the biodiversity of an ecosystem make predictions or draw conclusions about how the diversity contributes to the stability of the ecosystem.*

3. REPRODUCTION

- 1) Differentiate between asexual and sexual reproduction, and explain that in some kinds of organisms, all the genes come from one parent, while in organisms requiring two sexes to reproduce, typically half the genes come from each parent.
- 2) Explain that a species of sexually reproducing organisms is comprised of all the organisms that can mate to produce fertile offspring.
- 3) Explain that in sexual reproduction, a single specialized cell from a female merges with a specialized cell from a male in a process called fertilization.
- 4) Explain that the fertilized egg cell, carrying genetic information from each parent, multiplies to form the complete organism.
- 5) Explain how the basic tissues of an embryo form.

6) *Compare and contrast sexual reproduction with asexual reproduction.*

7) *Using data provided, select evidence that supports the concept that genetic information is passed on from both parents to offspring.*

LS 2 – Energy flows and matter recycles through an ecosystem.

1. ENVIRONMENT

- 1) Explain how changes in environmental conditions can affect the survival of individual organisms and an entire species.
- 2) Explain that in all environments, organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter, and that in any particular environment the growth and survival of organisms depend on the physical conditions.

3) *Using data and observations, predict outcomes when abiotic/biotic factors are changed in an ecosystem.*

2. FLOW OF ENERGY

- 1) Explain how food provides energy and materials for growth and repair of body parts.

2) *Given a scenario, trace the flow of energy through an ecosystem, beginning with the sun, through organisms in the food web, and into the environment (includes photosynthesis and respiration).*

3. RECYCLING OF MATERIALS

1. Identify autotrophs as producers who may use photosynthesis, and describe this as the basis of the food web.
2. Explain the process of respiration and differentiate between it and photosynthesis.
3. Know that all organisms, including humans, are part of, and depend on, two main interconnected global food webs, one which includes microscopic ocean plants, and the other which includes land plants.
4. Describe how matter is recycled within ecosystems and explain that the total amount of matter remains the same, though its form and location change.
5. Identify carbon, hydrogen, oxygen, nitrogen and phosphorus as common elements of living matter.

6. *Given an ecosystem, trace how matter cycles among and between organisms and the physical environment (includes water, oxygen, food web, decomposition, recycling but not carbon cycle or nitrogen cycle).*

LS 3 – Groups of organisms show evidence of change over time (e.g. evolution, natural selection, structures, behaviors, and biochemistry).

1. CHANGE

- 1) Describe the type of impact certain environmental changes, including deforestation, invasive species, increased erosion, and pollution containing toxic substances, could have on local environments.

2. EVIDENCE OF EVOLUTION

- 1) Describe how the fossil record provides geologic evidence verifying the existence of now extinct life forms, and explains how this evidence provides documented proof of their appearance, diversification and extinction.
- 2) Explain the concept of extinction and describes its importance in biological evolution.
- 3) *Use a model, classification system, or dichotomous key to illustrate, compare, or interpret possible relationships among groups of organisms (e.g., internal and external structures, anatomical features).*

3. NATURAL SELECTION

- 1) Recognize that hereditary information is contained in genes, which are located in the chromosomes of each cell, explain that inherited traits can be determined by either one or many genes, and that a single gene can influence more than one trait, such as eye and hair color.
- 2) Recognize that in any given environment the growth and survival of organisms depend on the physical conditions that exist, and explain that in all environments, organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter.
- 3) Explain how individual organisms with certain traits are more likely than others to survive and have offspring.
- 4) Recognize that humans are able to control some characteristics of plants and animals through selective breeding; and explain how this results in small differences between the parents and offspring, which can accumulate in successive generations so that decedents are very different from their ancestors.

- 5) *Cite examples supporting the concept that certain traits of organisms may provide a survival advantage in a specific environment and therefore, an increased likelihood to produce offspring.*

LS4 – Humans are similar to other species in many ways, and yet are unique among Earth’s life forms.

1. BEHAVIOR

- 1) Recognize that unlike human beings, behavior in insects and many other species is determined almost entirely by biological inheritance.
- 2) Explain that organism’s behavioral response is a reaction to internal or and environmental stimuli, and that these responses may be determined by heredity or from past experience.
- 3) Explain how all behavior is affected by both inheritance and experience.

2. DISEASE

- 1) Recognize that disease in organisms can be caused by intrinsic failures of the system or infection from other organisms.
- 2) Describe how viruses, bacteria, fungi, and parasites may affect the human body and provide examples of how they can interfere with normal body function.
- 3) Describe the function of white blood cells and explain how they support the bodies defense system.

- 4) *Use data and observations to support the concept that environmental or biological factors affect human body systems (biotic & abiotic).*

3. HUMAN IDENTITY

- 1) Compare patterns of human development with those of other vertebrates.
- 2) Recognize that an organism can be described in terms of a combination of traits, and differentiate between inherited traits and those that result from interactions with the environment.

- 3) *Describe the major changes that occur over time in human development from single cell through embryonic development to new born (i.e., trimesters: 1st – group of cells, 2nd - organs form, 3rd - organs mature).*

- 4) *Using data provided, select evidence that supports the concept that genetic information is passed on from both parents to offspring.*

LS5 – The growth of scientific knowledge in Life Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.

1. DESIGN TECHNOLOGY

- 1) Explain how technology has influenced the course of history, and provide examples such as those that relate to agriculture, sanitation and medicine.
- 2) Provide examples of ways technology is used to protect the environment, such as using bacteria to clean water.

2. TOOLS
 - 1) Recognizes and provide examples of how technology has enhanced the study of life sciences, as in the development of advanced diagnosing equipment improving medicine.
 3. SOCIAL ISSUES (LOCAL AND GLOBAL)
 - MEDICAL TECHNOLOGIES
 - 1) Explain the necessity of, and purpose for the proper disposal of medical products.
 - BIOTECHNOLOGIES
 - 2) Give examples of how increased understanding of biology has led to improvements in biotechnology, such as scientific methods for increasing the yield or the pest-resistance of important food crops.
 - 3) Describes ways biotechnology helps humans, including improved health and medicine.
 4. CAREER AND TECHNICAL EDUCATION CONNECTIONS
 - 1) Understand that some scientific jobs/careers involve the application of life science content knowledge and experience in specific ways that meet the goals of the job.
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Physical Science

PS1 – All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size/amount of substance).

1. COMPOSITION
 - 1) Explain that atoms often combine to form a molecule or formula unit (crystal).
 - 2) Recognize that elements can combine in a variety of ways to form compounds.
 - 3) Differentiate between an atom and an molecule
 - 4) Differentiate between a mixture and a pure substance.
 - 5) Identify methods used to separate mixtures, such as boiling, filtering, chromatography and screening.
 - 6) *Collect data or use data provided to infer or predict that the total amount of mass in a closed system stays the same, regardless of how substances interact (conservation of matter).*
 - 7) *Given graphic or written information, classify matter as atom/molecule or element/compound (Not the structure of an atom).*
2. PROPERTIES
 - 1) Differentiate between volume and mass and define density.
 - 2) Explain how different substances of equal volume usually have different weights.
 - 3) Identify a molecule as the smallest part of a substance that retains its properties.
 - 4) *Investigate the relationships among mass, volume and density.*
 - 5) *Given data about characteristic properties of matter (e.g., melting and boiling points, density, solubility) identify, compare, or classify different substances.*
 - 6) *Represent or explain the relationship between or among energy, molecular motion, temperature, and states of matter.*

PS2 – Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.

1. CHANGE

- 1) Explain how substances react chemically with other substances to form new substances, known as compounds, and that in such recombination's, the properties of the new substances may be very different from those of the old.
- 2) Identify factors that affect reaction rates, such as temperature, concentration and surface area, and explain that dissolving substances in liquids often accelerates reaction rates.
- 3) Explain that oxidation involves combining oxygen with another substance, as in burning or rusting.
- 4) Explain that states of matter depend on the arrangement of the molecules and their motion.
- 5) *Given a real-world example, show that within a system, energy transforms from one form to another (i.e., chemical, heat, electrical, gravitational, light, sound, mechanical).*

2. CONSERVATION

- 1) Explain the law of conservation of energy.

3. ENERGY

- 1) Differentiate between kinetic energy, which is the energy of motion and potential energy, which depends on relative position.
- 2) Recognize the Sun is a major energy source for the Earth, and describes how it affects the planet's surface.
- 3) Describe ways light can interact with matter, such as transmission, which includes refraction, absorption, and scattering, which includes reflection.
- 4) Explain that the human eye can only detect wavelengths of electromagnetic radiation within a narrow range, and explain that the differences of wavelength within that range of visible light are perceived as differences in color.
- 5) Recognize that most chemical and nuclear reactions involve a transfer of energy.
- 6) *Use data to draw conclusions about how heat can be transferred (convection, conduction, radiation).*

PS3 – The motion of an object is affected by force.

1. FORCES

- 1) Explain that the force of gravity gets stronger the closer one gets to an object and decreases the further away one gets from it.
- 2) Recognize the general concepts related to gravitational force.
- 3) *Use data to determine or predict the overall (net) effect of multiple forces (e.g., friction, gravitational, magnetic) on the position, speed, and direction of motion of objects.*

2. MOTION

- 1) Explain that an object in motion that is unaffected by a force will continue to move at a constant speed and in a straight line.
- 2) Explain how the motion of an object can be described by its position, direction of motion, and speed, and illustrate how that motion can be measured and represented graphically.

PS4 – The growth of scientific knowledge in Physical Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.

1. DESIGN TECHNOLOGY

- 1) Understand that design features, such as size shape, weight, and function, must be considered when designing new technology.

2. TOOLS

- 1) Demonstrate appropriate use of tools, such as rulers, calculators, balances, and graduated cylinders to measure and calculate volume and mass

3. SOCIAL ISSUES (LOCAL & GLOBAL)

ENERGY, POWER AND TRANSPORTATION

- 1) Explain how humans use natural resources, such as flowing water and burning of coal, oil, or natural gas to generate electrical energy in power plants.
- 2) Describe how natural resources, such as coal, oil and natural gas are tapped for use in power plants, and how alternative sources, such as solar, wind, water, nuclear are tapped for power, and compare the advantages and disadvantages of each source.

MANUFACTURING

- 3) Differentiate between durable goods, which are designed to operate for a long period of time, and non-durable goods, which are only intended to operate for a short period of time.

4. CAREER TECHNICAL EDUCATION CONNECTIONS

- 1) Understand that some scientific jobs/careers involve the application of physical science content knowledge and experience in specific ways that meet the goals of the job.