Science Content Standards

Grade Six

Focus on Earth Science

Plate Tectonics and Earth's Structure

1. Plate tectonics accounts for important features of Earth's surface and major geologic events. As a basis for understanding this concept:

a. *Students know* evidence of plate tectonics is derived from the fit of the continents; the location of earthquakes, volcanoes, and midocean ridges; and the distribution of fossils, rock types, and ancient climatic zones.
b. *Students know* Earth is composed of several layers: a cold, brittle lithosphere; a hot, convecting mantle; and a dense, metallic core.
c. *Students know* lithospheric plates the size of continents and oceans move at rates of centimeters per year in response to movements in the mantle.
d. *Students know* that earthquakes are sudden motions along breaks in the crust called faults and that volcanoes and fissures are locations where magma reaches the surface.
e. *Students know* major geologic events, such as earthquakes, volcanic eruptions, and mountain building, result from plate motions.
f. *Students know* how to explain major features of California geology (including mountains, faults, volcanoes) in terms of plate tectonics.
g. *Students know* how to determine the epicenter of an earthquake and know that the effects of an earthquake on any region vary, depending on the size of the earthquake, the distance of the region from the epicenter, the local geology, and the type of construction in the region.

Shaping Earth's Surface

2. Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment. As a basis for understanding this concept:

a. *Students know* water running downhill is the dominant process in shaping the landscape, including California's landscape.
b. *Students know* rivers and streams are dynamic systems that erode, transport sediment, change course, and flood their banks in natural and recurring patterns.
c. *Students know* beaches are dynamic systems in which the sand is supplied by rivers and moved along the coast by the action of waves.

d. *Students know* earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats.

Heat (Thermal Energy) (Physical Science)

Grade Seven

Focus on Life Science

Cell Biology

1. All living organisms are composed of cells, from just one to many trillions, whose details usually are visible only through a microscope. As a basis for understanding this concept:

a. *Students know* cells function similarly in all living organisms. b. *Students know* the characteristics that distinguish plant cells from animal cells, including chloroplasts and cell walls.
c. *Students know* the nucleus is the repository for genetic information in plant and animal cells.
d. *Students know* that mitochondria liberate energy for the work that cells do and that chloroplasts capture sunlight energy for photosynthesis.
e. *Students know* cells divide to increase their numbers through a process of mitosis, which results in two daughter cells with identical sets of chromosomes.
f. *Students know* that as multicellular organisms develop, their cells differentiate.

Genetics

2. A typical cell of any organism contains genetic instructions that specify its traits. Those traits may be modified by environmental influences. As a basis for under-standing this concept:

a. *Students know* the differences between the life cycles and reproduction methods of sexual and asexual organisms.
b. *Students know* sexual reproduction produces offspring that inherit half their genes from each parent.
c. *Students know* an inherited trait can be determined by one or more genes.
d. *Students know* plant and animal cells contain many thousands of different genes and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive.
e. *Students know* DNA (deoxyribonucleic acid) is the genetic material of living organisms and is located in the chromosomes of each cell.

Evolution

3. Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept:

a. *Students know* both genetic variation and environmental factors are causes of evolution and diversity of organisms.
b. *Students know* the reasoning used by Charles Darwin in reaching

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Focus on Physical Science

Motion

1. The velocity of an object is the rate of change of its position. As a basis for under-standing this concept:

a. *Students know* position is defined in relation to some choice of a standard reference point and a set of reference directions.
b. *Students know* that average speed is the total distance traveled divided by the total time elapsed and that the speed of an object along the path traveled can vary.
c. *Students know* how to solve problems involving distance, time, and average speed.
d. *Students know* the velocity of an object must be described by specifying both the direction and the speed of the object.
e. *Students know* changes in velocity may be due to changes in speed, direction, or both.
f. *Students know* how to interpret graphs of position versus time and graphs of speed versus time for motion in a single direction.

Forces

2. Unbalanced forces cause changes in velocity. As a basis for understanding this concept:

a. *Students know* a force has both direction and magnitude.
b. *Students know* when an object is subject to two or more forces at once, the result is the cumulative effect of all the forces.
c. *Students know* when the forces on an object are balanced, the motion of the object does not change.
d. *Students know* how to identify separately the two or more forces that are acting onÊ a single static object, including gravity, elastic forces due to tension or compression in matter, and friction.
e. *Students know* that when the forces on an object are unbalanced, the object will change its velocity (that is, it will speed up, slow down, or change direction).
f. *Students know* the greater the mass of an object, the more force is needed to achieve the same rate of change in motion.
g. *Students know* the role of gravity in forming and maintaining the shapes of planets, stars, and the solar system.

Structure of Matter

3. Each of the more than 100 elements of matter has distinct properties and a distinct atomic structure. All forms of matter are composed of one or more of the elements. As a basis for understanding this concept:

a. *Students know* the structure of the atom and know it is composed of protons, neutrons, and electrons.
b. *Students know* that compounds are formed by combining two or

3. Heat moves in a predictable flow from warmer objects to cooler objects until all the objects are at the same temperature. As a basis for understanding this concept:

a. *Students know* energy can be carried from one place to another by heat flow or by waves, including water, light and sound waves, or by moving objects.

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b. *Students know* that when fuel is consumed, most of the energy released becomes heat energy.
c. *Students know* heat flows in solids by conduction (which involves no flow of matter) and in fluids by conduction and by convection (which involves flow of matter).
d. *Students know* heat energy is also transferred between objects by radiation (radiation can travel through space).

Energy in the Earth System

4. Many phenomena on Earth's surface are affected by the transfer of energy through radiation and convection currents. As a basis for understanding this concept:

a. *Students know* the sun is the major source of energy for phenomena on Earth's surface; it powers winds, ocean currents, and the water cycle.
b. *Students know* solar energy reaches Earth through radiation, mostly in the form of visible light.
c. *Students know* heat from Earth's interior reaches the surface primarily through convection.
d. *Students know* convection currents distribute heat in the atmosphere and oceans.
e. *Students know* differences in pressure, heat, air movement, and humidity result in changes of weather.

Ecology (Life Science)

5. Organisms in ecosystems exchange energy and nutrients among themselves and with the environment. As a basis for understanding this concept:

a. *Students know* energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food webs.
b. *Students know* matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.
c. *Students know* populations of organisms can be categorized by the functions they serve in an ecosystem.
d. *Students know* different kinds of organisms may play similar ecological roles in similar biomes.
e. *Students know* the number and types of organisms an ecosystem

his conclusion that natural selection is the mechanism of evolution.
c. *Students know* how independent lines of evidence from geology, fossils, and comparative anatomy provide the bases for the theory of evolution.
d. *Students know* how to construct a simple branching diagram to classify living groups of organisms by shared derived characteristics and how to expand the diagram to include fossil organisms.

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e. *Students know* that extinction of a species occurs when the environment changes and that the adaptive characteristics of a species are insufficient for its survival.

Earth and Life History (Earth Science)

4. Evidence from rocks allows us to understand the evolution of life on Earth. As a basis for understanding this concept:

a. *Students know* Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.
b. *Students know* the history of life on Earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impacts of asteroids.
c. *Students know* that the rock cycle includes the formation of new sediment and rocks and that rocks are often found in layers, with the oldest generally on the bottom.
d. *Students know* that evidence from geologic layers and radioactive dating indicates Earth is approximately 4.6 billion years old and that life on this planet has existed for more than 3 billion years.
e. *Students know* fossils provide evidence of how life and environmental conditions have changed.
f. *Students know* how movements of Earth's continental and oceanic plates through time, with associated changes in climate and geographic connections, have affected the past and present distribution of organisms.
g. *Students know* how to explain significant developments and extinctions of plant and animal life on the geologic time scale.

Structure and Function in Living Systems

5. The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. As a basis for understanding this concept:

a. *Students know* plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.
b. *Students know* organ systems function because of the contributions of individual organs, tissues, and cells. The failure of any part can affect the entire system.
c. *Students know* how bones and muscles work together to provide a

more different elements and that compounds have properties that are different from their constituent elements.
c. *Students know* atoms and molecules form solids by building up repeating patterns, such as the crystal structure of NaCl or long-chain polymers.
d. *Students know* the states of matter (solid, liquid, gas) depend on molecular motion.

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e. *Students know* that in solids the atoms are closely locked in position and can only vibrate; in liquids the atoms and molecules are more loosely connected and can collide with and move past one another; and in gases the atoms and molecules are free to move independently, colliding frequently.
f. *Students know* how to use the periodic table to identify elements in simple compounds.

Earth in the Solar System (Earth Science)

4. The structure and composition of the universe can be learned from studying stars and galaxies and their evolution. As a basis for understanding this concept:

a. *Students know* galaxies are clusters of billions of stars and may have different shapes.
b. *Students know* that the Sun is one of many stars in the Milky Way galaxy and that stars may differ in size, temperature, and color.
c. *Students know* how to use astronomical units and light years as measures of distances between the Sun, stars, and Earth.
d. *Students know* that stars are the source of light for all bright objects in outer space and that the Moon and planets shine by reflected sunlight, not by their own light.
e. *Students know* the appearance, general composition, relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids.

Reactions

5. Chemical reactions are processes in which atoms are rearranged into different combinations of molecules. As a basis for understanding this concept:

a. *Students know* reactant atoms and molecules interact to form products with different chemical properties.
b. *Students know* the idea of atoms explains the conservation of matter: In chemical reactions the number of atoms stays the same no matter how they are arranged, so their total mass stays the same.
c. *Students know* chemical reactions usually liberate heat or absorb heat.
d. *Students know* physical processes include freezing and boiling, in which a material changes form with no chemical reaction.

can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.

Resources

6. Sources of energy and materials differ in amounts, distribution, usefulness, and the time required for their formation. As a basis for understanding this concept:

a. *Students know* the utility of energy sources is determined by factors that are involved in converting these sources to useful forms and the consequences of the conversion process.
b. *Students know* different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forests, and know how to classify them as renewable or nonrenewable.

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c. *Students know* the natural origin of the materials used to make common objects.

Investigation and Experimentation

7. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

a. Develop a hypothesis.
b. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
c. Construct appropriate graphs from data and develop qualitative statements about the relationships between variables.
d. Communicate the steps and results from an investigation in written reports and oral presentations.
e. Recognize whether evidence is consistent with a proposed explanation.
f. Read a topographic map and a geologic map for evidence provided on the maps and construct and interpret a simple scale map.
g. Interpret events by sequence and time from natural phenomena (e.g., the relative ages of rocks and intrusions).
h. Identify changes in natural phenomena over time without manipulating the phenomena (e.g., a tree limb, a grove of trees, a stream, a hillslope).

structural framework for movement.
d. *Students know* how the reproductive organs of the human female and male generate eggs and sperm and how sexual activity may lead to fertilization and pregnancy.
e. *Students know* the function of the umbilicus and placenta during pregnancy.
f. *Students know* the structures and processes by which flowering plants generate pollen, ovules, seeds, and fruit.
g. *Students know* how to relate the structures of the eye and ear to their functions.

Physical Principles in Living Systems (Physical Science)

6. Physical principles underlie biological structures and functions. As a basis for understanding this concept:

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a. *Students know* visible light is a small band within a very broad electromagnetic spectrum.
b. *Students know* that for an object to be seen, light emitted by or scattered from it must be detected by the eye.
c. *Students know* light travels in straight lines if the medium it travels through does not change.
d. *Students know* how simple lenses are used in a magnifying glass, the eye, a camera, a telescope, and a microscope.
e. *Students know* that white light is a mixture of many wavelengths (colors) and that retinal cells react differently to different wavelengths.
f. *Students know* light can be reflected, refracted, transmitted, and absorbed by matter.
g. *Students know* the angle of reflection of a light beam is equal to the angle of incidence.
h. *Students know* how to compare joints in the body (wrist, shoulder, thigh) with structures used in machines and simple devices (hinge, ball-and-socket, and sliding joints).
i. *Students know* how levers confer mechanical advantage and how the application of this principle applies to the musculoskeletal system.
j. *Students know* that contractions of the heart generate blood pressure and that heart valves prevent backflow of blood in the circulatory system.

Investigation and Experimentation

7. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

a. Select and use appropriate tools and technology (including

e. *Students know* how to determine whether a solution is acidic, basic, or neutral.

Chemistry of Living Systems (Life Science)

6. Principles of chemistry underlie the functioning of biological systems. As a basis for understanding this concept:

a. *Students know* that carbon, because of its ability to combine in many ways with itself and other elements, has a central role in the chemistry of living organisms.
b. *Students know* that living organisms are made of molecules consisting largely of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.
c. *Students know* that living organisms have many different kinds of molecules, including small ones, such as water and salt, and very large ones, such as carbohydrates, fats, proteins, and DNA.

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Periodic Table

7. The organization of the periodic table is based on the properties of the elements and reflects the structure of atoms. As a basis for understanding this concept:

a. *Students know* how to identify regions corresponding to metals, nonmetals, and inert gases.
b. *Students know* each element has a specific number of protons in the nucleus (the atomic number) and each isotope of the element has a different but specific number of neutrons in the nucleus.
c. *Students know* substances can be classified by their properties, including their melting temperature, density, hardness, and thermal and electrical conductivity.

Density and Buoyancy

8. All objects experience a buoyant force when immersed in a fluid. As a basis for understanding this concept:

a. *Students know* density is mass per unit volume.
b. *Students know* how to calculate the density of substances (regular and irregular solids and liquids) from measurements of mass and volume.
c. *Students know* the buoyant force on an object in a fluid is an upward force equal to the weight of the fluid the object has displaced.
d. *Students know* how to predict whether an object will float or sink.

Investigation and Experimentation

9. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands,

	calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data. b. Use a variety of print and electronic resources (including the World Wide Web) to collect information and evidence as part of a research project. c. Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence. d. Construct scale models, maps, and appropriately labeled diagrams to communicate scientific knowledge (e. g., motion of Earth's plates and cell structure). e. Communicate the steps and results from an investigation in written reports and oral presentations.	students should develop their own questions and perform investigations. Students will: a. Plan and conduct a scientific investigation to test a hypothesis. b. Evaluate the accuracy and reproducibility of data. c. Distinguish between variable and controlled parameters in a test. d. Recognize the slope of the linear graph as the constant in the relationship $y = kx$ and apply this principle in interpreting graphs constructed from data. e. Construct appropriate graphs from data and develop quantitative statements about the relationships between variables. f. Apply simple mathematic relationships to determine a missing quantity in a mathematic expression, given the two remaining terms (including speed = distance/time, density = mass/volume, force = pressure x area, volume = area x height). g. Distinguish between linear and nonlinear relationships on a graph of data.