

Science Content Standards for California Public Schools: Kindergarten Through Grade Eight (1998)

KINDERGARTEN

Physical Sciences

1. Properties of materials can be observed, measured, and predicted. As a basis for understanding this concept:

- Students know* objects can be described in terms of the materials they are made of (e.g., clay, cloth, paper) and their physical properties (e.g., color, size, shape, weight, texture, flexibility, attraction to magnets, floating, sinking).
- Students know* water can be a liquid or a solid and can be made to change back and forth from one form to the other.
- Students know* water left in an open container evaporates (goes into the air) but water in a closed container does not.

Life Sciences

2. Different types of plants and animals inhabit the earth. As a basis for understanding this concept:

- Students know* how to observe and describe similarities and differences in the appearance and behavior of plants and animals (e.g., seed-bearing plants, birds, fish, insects).
- Students know* stories sometimes give plants and animals attributes they do not really have.
- Students know* how to identify major structures of common plants and animals (e.g., stems, leaves, roots, arms, wings, legs).

Earth Sciences

3. Earth is composed of land, air, and water. As a basis for understanding this concept:

- Students know* characteristics of mountains, rivers, oceans, valleys, deserts, and local landforms.
- Students know* changes in weather occur from day to day and across seasons, affecting Earth and its inhabitants.
- Students know* how to identify resources from Earth that are used in everyday life and understand that many resources can be conserved.

Investigation and Experimentation

4. 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:

- Observe common objects by using the five senses.
- Describe the properties of common objects.
- Describe the relative position of objects by using one reference (e.g., above or below).
- Compare and sort common objects by one physical attribute (e.g., color, shape, texture, size, weight).
- Communicate observations orally and through drawings.

GRADE ONE

Physical Sciences

1. Materials come in different forms (states), including solids, liquids, and gases.

As a basis for understanding this concept:

- Students know* solids, liquids, and gases have different properties.
- Students know* the properties of substances can change when the substances are mixed, cooled, or heated.

Life Sciences

2. Plants and animals meet their needs in different ways. As a basis for understanding this concept:

- Students know* different plants and animals inhabit different kinds of environments and have external features that help them thrive in different kinds of places.
- Students know* both plants and animals need water, animals need food, and plants need light.
- Students know* animals eat plants or other animals for food and may also use plants or even other animals for shelter and nesting.
- Students know* how to infer what animals eat from the shapes of their teeth (e.g., sharp teeth: eats meat; flat teeth: eats plants).
- Students know* roots are associated with the intake of water and soil nutrients and green leaves are associated with making food from sunlight.

Earth Sciences

3. Weather can be observed, measured, and described. As a basis for understanding this concept:

- Students know* how to use simple tools (e.g., thermometer, wind vane) to measure weather conditions and record changes from day to day and across the seasons.
- Students know* that the weather changes from day to day but that trends in temperature or of rain (or snow) tend to be predictable during a season.
- Students know* the sun warms the land, air, and water.

Investigation and Experimentation

4. 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:

- Draw pictures that portray some features of the thing being described.
- Record observations and data with pictures, numbers, or written statements.
- Record observations on a bar graph.
- Describe the relative position of objects by using two references (e.g., above and next to, below and left of).
- Make new observations when discrepancies exist between two descriptions of the same object or phenomenon.

GRADE TWO

Physical Sciences

1. The motion of objects can be observed and measured. As a basis for understanding this concept:

- Students know* the position of an object can be described by locating it in relation to another object or to the background.
- Students know* an object's motion can be described by recording the change in position of the object over time.
- Students know* the way to change how something is moving is by giving it a push or a pull. The size of the change is related to the strength, or the amount of force, of the push or pull.
- Students know* tools and machines are used to apply pushes and pulls (forces) to make things move.
- Students know* objects fall to the ground unless something holds them up.
- Students know* magnets can be used to make some objects move without being touched.
- Students know* sound is made by vibrating objects and can be described by its pitch and volume.

Life Sciences

2. Plants and animals have predictable life cycles. As a basis for understanding this concept:

- Students know* that organisms reproduce offspring of their own kind and that the offspring resemble their parents and one another.
- Students know* the sequential stages of life cycles are different for different animals, such as butterflies, frogs, and mice.

- c. *Students know* many characteristics of an organism are inherited from the parents. Some characteristics are caused or influenced by the environment.
- d. *Students know* there is variation among individuals of one kind within a population.
- e. *Students know* light, gravity, touch, or environmental stress can affect the germination, growth, and development of plants.
- f. *Students know* flowers and fruits are associated with reproduction in plants.

Earth Sciences

- 3. Earth is made of materials that have distinct properties and provide resources for human activities. As a basis for understanding this concept:
 - a. *Students know* how to compare the physical properties of different kinds of rocks and know that rock is composed of different combinations of minerals.
 - b. *Students know* smaller rocks come from the breakage and weathering of larger rocks.
 - c. *Students know* that soil is made partly from weathered rock and partly from organic materials and that soils differ in their color, texture, capacity to retain water, and ability to support the growth of many kinds of plants.
 - d. *Students know* that fossils provide evidence about the plants and animals that lived long ago and that scientists learn about the past history of Earth by studying fossils.
 - e. *Students know* rock, water, plants, and soil provide many resources, including food, fuel, and building materials, that humans use.

Investigation and Experimentation

- 4. 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. Make predictions based on observed patterns and not random guessing.
 - b. Measure length, weight, temperature, and liquid volume with appropriate tools and express those measurements in standard metric system units.
 - c. Compare and sort common objects according to two or more physical attributes (e.g., color, shape, texture, size, weight).
 - d. Write or draw descriptions of a sequence of steps, events, and observations.
 - e. Construct bar graphs to record data, using appropriately labeled axes.
 - f. Use magnifiers or microscopes to observe and draw descriptions of small objects or small features of objects.
 - g. Follow oral instructions for a scientific investigation.

GRADE THREE

Physical Sciences

- 1. Energy and matter have multiple forms and can be changed from one form to another. As a basis for understanding this concept:
 - a. *Students know* energy comes from the Sun to Earth in the form of light.
 - b. *Students know* sources of stored energy take many forms, such as food, fuel, and batteries.
 - c. *Students know* machines and living things convert stored energy to motion and heat.
 - d. *Students know* energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects.
 - e. *Students know* matter has three forms: solid, liquid, and gas.
 - f. *Students know* evaporation and melting are changes that occur when the objects are heated.
 - g. *Students know* that when two or more substances are combined, a new substance may be formed with properties that are different from those of the original materials.
 - h. *Students know* all matter is made of small particles called atoms, too small to see with the naked eye.

- i. *Students know* people once thought that earth, wind, fire, and water were the basic elements that made up all matter. Science experiments show that there are more than 100 different types of atoms, which are presented on the periodic table of the elements.

- 2. Light has a source and travels in a direction. As a basis for understanding this concept:

- a. *Students know* sunlight can be blocked to create shadows.
- b. *Students know* light is reflected from mirrors and other surfaces.
- c. *Students know* the color of light striking an object affects the way the object is seen.
- d. *Students know* an object is seen when light traveling from the object enters the eye.

Life Sciences

- 3. Adaptations in physical structure or behavior may improve an organism's chance for survival. As a basis for understanding this concept:
 - a. *Students know* plants and animals have structures that serve different functions in growth, survival, and reproduction.
 - b. *Students know* examples of diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands, and wetlands.
 - c. *Students know* living things cause changes in the environment in which they live: some of these changes are detrimental to the organism or other organisms, and some are beneficial.
 - d. *Students know* when the environment changes, some plants and animals survive and reproduce; others die or move to new locations.
 - e. *Students know* that some kinds of organisms that once lived on Earth have completely disappeared and that some of those resembled others that are alive today.

Earth Sciences

- 4. Objects in the sky move in regular and predictable patterns. As a basis for understanding this concept:

- a. *Students know* the patterns of stars stay the same, although they appear to move across the sky nightly, and different stars can be seen in different seasons.
- b. *Students know* the way in which the Moon's appearance changes during the fourweek lunar cycle.
- c. *Students know* telescopes magnify the appearance of some distant objects in the sky, including the Moon and the planets. The number of stars that can be seen through telescopes is dramatically greater than the number that can be seen by the unaided eye.
- d. *Students know* that Earth is one of several planets that orbit the Sun and that the Moon orbits Earth.
- e. *Students know* the position of the Sun in the sky changes during the course of the day and from season to season.

Investigation and Experimentation

- 5. 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. Repeat observations to improve accuracy and know that the results of similar scientific investigations seldom turn out exactly the same because of differences in the things being investigated, methods being used, or uncertainty in the observation.
 - b. Differentiate evidence from opinion and know that scientists do not rely on claims or conclusions unless they are backed by observations that can be confirmed.
 - c. Use numerical data in describing and comparing objects, events, and measurements.
 - d. Predict the outcome of a simple investigation and compare the result with the prediction.
 - e. Collect data in an investigation and analyze those data to develop a logical conclusion.

GRADE FOUR

Physical Sciences

- Electricity and magnetism are related effects that have many useful applications in everyday life. As a basis for understanding this concept:
 - Students know* how to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.
 - Students know* how to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.
 - Students know* electric currents produce magnetic fields and know how to build a simple electromagnet.
 - Students know* the role of electromagnets in the construction of electric motors, electric generators, and simple devices, such as doorbells and earphones.
 - Students know* electrically charged objects attract or repel each other.
 - Students know* that magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.
 - Students know* electrical energy can be converted to heat, light, and motion.

Life Sciences

- All organisms need energy and matter to live and grow. As a basis for understanding this concept:
 - Students know* plants are the primary source of matter and energy entering most food chains.
 - Students know* producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.
 - Students know* decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.
- Living organisms depend on one another and on their environment for survival. As a basis for understanding this concept:
 - Students know* ecosystems can be characterized by their living and nonliving components.
 - Students know* that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
 - Students know* many plants depend on animals for pollination and seed dispersal, and animals depend on plants for food and shelter.
 - Students know* that most microorganisms do not cause disease and that many are beneficial.

Earth Sciences

- The properties of rocks and minerals reflect the processes that formed them. As a basis for understanding this concept:
 - Students know* how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).
 - Students know* how to identify common rock-forming minerals (including quartz, calcite, feldspar, mica, and hornblende) and ore minerals by using a table of diagnostic properties.
- Waves, wind, water, and ice shape and reshape Earth's land surface. As a basis for understanding this concept:
 - Students know* some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.
 - Students know* natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.
 - Students know* moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).

Investigation and Experimentation

- 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:
 - Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
 - Measure and estimate the weight, length, or volume of objects.
 - Formulate and justify predictions based on cause-and-effect relationships.
 - Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
 - Construct and interpret graphs from measurements.
 - Follow a set of written instructions for a scientific investigation.

GRADE FIVE

Physical Sciences

- Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept:
 - Students know* that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
 - Students know* all matter is made of atoms, which may combine to form molecules.
 - Students know* metals have properties in common, such as high electrical and thermal conductivity. Some metals, such as aluminum (Al), iron (Fe), nickel (Ni), copper (Cu), silver (Ag), and gold (Au), are pure elements; others, such as steel and brass, are composed of a combination of elemental metals.
 - Students know* that each element is made of one kind of atom and that the elements are organized in the periodic table by their chemical properties.
 - Students know* scientists have developed instruments that can create discrete images of atoms and molecules that show that the atoms and molecules often occur in well-ordered arrays.
 - Students know* differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.
 - Students know* properties of solid, liquid, and gaseous substances, such as sugar (C₆H₁₂O₆), water (H₂O), helium (He), oxygen (O₂), nitrogen (N₂), and carbon dioxide (CO₂).
 - Students know* living organisms and most materials are composed of just a few elements.
 - Students know* the common properties of salts, such as sodium chloride (NaCl).

Life Sciences

- Plants and animals have structures for respiration, digestion, waste disposal, and transport of materials. As a basis for understanding this concept:
 - Students know* many multicellular organisms have specialized structures to support the transport of materials.
 - Students know* how blood circulates through the heart chambers, lungs, and body and how carbon dioxide (CO₂) and oxygen (O₂) are exchanged in the lungs and tissues.
 - Students know* the sequential steps of digestion and the roles of teeth and the mouth, esophagus, stomach, small intestine, large intestine, and colon in the function of the digestive system.
 - Students know* the role of the kidney in removing cellular waste from blood and converting it into urine, which is stored in the bladder.
 - Students know* how sugar, water, and minerals are transported in a vascular plant.
 - Students know* plants use carbon dioxide (CO₂) and energy from sunlight to build molecules of sugar and release oxygen.
 - Students know* plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO₂) and water (respiration).

Earth Sciences

3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept:

- Students know* most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.
- Students know* when liquid water evaporates, it turns into water vapor in the air and can reappear as a liquid when cooled or as a solid if cooled below the freezing point of water.
- Students know* water vapor in the air moves from one place to another and can form fog or clouds, which are tiny droplets of water or ice, and can fall to Earth as rain, hail, sleet, or snow.
- Students know* that the amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited and that its availability can be extended by recycling and decreasing the use of water.
- Students know* the origin of the water used by their local communities.

4. Energy from the Sun heats Earth unevenly, causing air movements that result in changing weather patterns. As a basis for understanding this concept:

- Students know* uneven heating of Earth causes air movements (convection currents).
- Students know* the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns.
- Students know* the causes and effects of different types of severe weather.
- Students know* how to use weather maps and data to predict local weather and know that weather forecasts depend on many variables.
- Students know* that the Earth's atmosphere exerts a pressure that decreases with distance above Earth's surface and that at any point it exerts this pressure equally in all directions.

5. The solar system consists of planets and other bodies that orbit the Sun in predictable paths. As a basis for understanding this concept:

- Students know* the Sun, an average star, is the central and largest body in the solar system and is composed primarily of hydrogen and helium.
- Students know* the solar system includes the planet Earth, the Moon, the Sun, eight other planets and their satellites, and smaller objects, such as asteroids and comets.
- Students know* the path of a planet around the Sun is due to the gravitational attraction between the Sun and the planet.

Investigation and Experimentation

6. 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:

- Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
- Develop a testable question.
- Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- Identify the dependent and controlled variables in an investigation.
- Identify a single independent variable in a scientific investigation and explain how this variable can be used to collect information to answer a question about the results of the experiment.
- Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.
- Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions.

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:

- 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.
- Students know* Earth is composed of several layers: a cold, brittle lithosphere; a hot, convecting mantle; and a dense, metallic core.
- Students know* lithospheric plates the size of continents and oceans move at rates of centimeters per year in response to movements in the mantle.
- 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.
- Students know* major geologic events, such as earthquakes, volcanic eruptions, and mountain building, result from plate motions.
- Students know* how to explain major features of California geology (including mountains, faults, volcanoes) in terms of plate tectonics.
- 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:

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

Heat (Thermal Energy) (Physical Science)

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:

- 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.
- Students know* that when fuel is consumed, most of the energy released becomes heat energy.
- 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).
- 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:

- 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.
- Students know* solar energy reaches Earth through radiation, mostly in the form of visible light.
- Students know* heat from Earth's interior reaches the surface primarily through convection.
- Students know* convection currents distribute heat in the atmosphere and oceans.
- 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:
- 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.
 - Students know* matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.
 - Students know* populations of organisms can be categorized by the functions they serve in an ecosystem.
 - Students know* different kinds of organisms may play similar ecological roles in similar biomes.
 - Students know* the number and types of organisms an ecosystem 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:
- 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.
 - 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.
 - 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:
- Develop a hypothesis.
 - Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
 - Construct appropriate graphs from data and develop qualitative statements about the relationships between variables.
 - Communicate the steps and results from an investigation in written reports and oral presentations.
 - Recognize whether evidence is consistent with a proposed explanation.
 - Read a topographic map and a geologic map for evidence provided on the maps and construct and interpret a simple scale map.
 - Interpret events by sequence and time from natural phenomena (e.g., the relative ages of rocks and intrusions).
 - Identify changes in natural phenomena over time without manipulating the phenomena (e.g., a tree limb, a grove of trees, a stream, a hillslope).

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:
- Students know* cells function similarly in all living organisms.
 - Students know* the characteristics that distinguish plant cells from animal cells, including chloroplasts and cell walls.
 - Students know* the nucleus is the repository for genetic information in plant and animal cells.
 - Students know* that mitochondria liberate energy for the work that cells do and

that chloroplasts capture sunlight energy for photosynthesis.

- Students know* cells divide to increase their numbers through a process of mitosis, which results in two daughter cells with identical sets of chromosomes.
- 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 understanding this concept:
- Students know* the differences between the life cycles and reproduction methods of sexual and asexual organisms.
 - Students know* sexual reproduction produces offspring that inherit half their genes from each parent.
 - Students know* an inherited trait can be determined by one or more genes.
 - 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.
 - 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:
- Students know* both genetic variation and environmental factors are causes of evolution and diversity of organisms.
 - Students know* the reasoning used by Charles Darwin in reaching his conclusion that natural selection is the mechanism of evolution.
 - Students know* how independent lines of evidence from geology, fossils, and comparative anatomy provide the bases for the theory of evolution.
 - 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.
 - 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:
- 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.
 - 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.
 - 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.
 - 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.
 - Students know* fossils provide evidence of how life and environmental conditions have changed.
 - 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.
 - 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 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:

- 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 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.

GRADE EIGHT

Focus on Physical Science

Motion

1. The velocity of an object is the rate of change of its position. As a basis for understanding 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 on 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 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.
- 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.
- 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.

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, 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 \times area, volume = area \times height).
- g. Distinguish between linear and nonlinear relationships on a graph of data.

CALIFORNIA SCIENCE CONTENT STANDARDS MATRIX

Grade Level	Physical Sciences	Life Sciences	Earth Sciences	Investigation & Experimentation
K	1a, b, c	2a, b, c	3a, b, c	4a, b, c, d, e
1	1a, b	2a, b, c, d, e	3a, b, c	4a, b, c, d, e
2	1a, b, c, d, e, f, g	2a, b, c, d, e, f	3a, b, c, d, e	4a, b, c, d, e, f, g
3	1a, b, c, d, e, f, g, h, i 2a, b, c, d	3a, b, c, d, e	4a, b, c, d, e	5a, b, c, d, e
4	1a, b, c, d, e, f, g	2a, b, c 3a, b, c, d	4a, b 5a, b, c	6a, b, c, d, e, f
5	1a, b, c, d, e, f, g, h, i	2a, b, c, d, e, f, g	3a, b, c, d, e 4a, b, c, d, e 5a, b, c	6a, b, c, d, e, f, g, h, i
6	3a, b, c, d	5a, b, c, d, e	1a, b, c, d, e, f, g 2a, b, c, d 4a, b, c, d, e 6a, b, c	7a, b, c, d, e, f, g, h
7	6a, b, c, d, e, f, g, h, i, j	1a, b, c, d, e, f 2a, b, c, d, e 3a, b, c, d, e 5a, b, c, d, e, f, g	4a, b, c, d, e, f, g	7a, b, c, d, e
8	1a, b, c, d, e, f 2a, b, c, d, e, f, g 3a, b, c, d, e, f 5a, b, c, d, e 7a, b, c 8a, b, c, d	6a, b, c	4a, b, c, d, e	9a, b, c, d, e, f, g