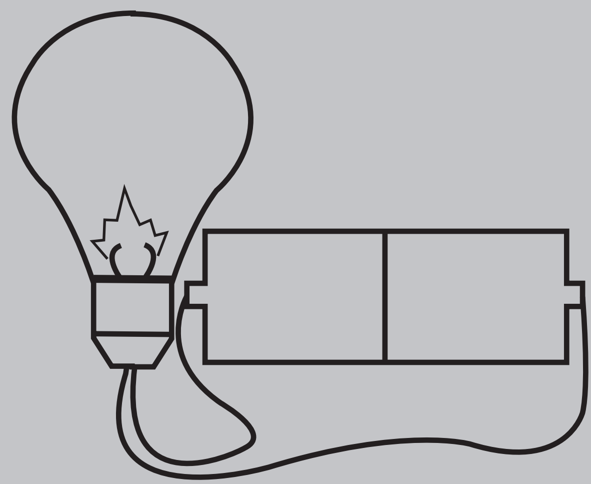
L A U S D

Elementary Science Instructional Guide



Grade 4

Instructional Services Division

Articulation Section

The purpose of this Articulation Section is to provide teachers, administrators, and professional development providers with resources from the *Grade 5 Elementary Science Instructional Guide* to assist in articulation and coordination between grades 4 and 5.

For each module of instruction (physical, life and Earth Science), the following resources are provided:

Key Knowledge and Concepts from the California Science Framework.

Module Vocabulary Chart

Core Vocabulary Defined

K e y   k n o w l e d g e   a n d   C o n c e p t s

Grade 5 - Physical Science Content Standards	Key Knowledge and Concepts from the California Science Framework
1a. *Students know* that during chemical reactions the atoms in the reactants rearrange to form products with different properties.	• Properties are used to identify atoms, elements, molecules, and compounds. • When atoms in molecules rearrange, no atoms are lost. • When atoms rearrange, they form new combinations with different properties (conservation of matter). • Reactants and products can be identified when observing a chemical reaction.
1b. *Students know* all matter is made of atoms, which may combine to form molecules.	• Matter is made of atoms. • Atoms can combine to form molecules. Common examples of simple molecules include: water (H_2O), nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), methane (CH_4), and propane (C_3H_8). • There is a small variety of atoms (elements) compared to the large variety of different molecules (compounds). • Simple molecules can be represented by molecular models to enhance student understanding of symbolic representations of molecules in text.
1c. *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.	• Elements are grouped on the Periodic Table based on their chemical properties, which are determined by their atomic structure. • All pure, elemental metals have high electrical and thermal conductivity. • Some metals are pure elements [gold (Au), silver (Ag), copper (Cu), iron (Fe), aluminum (Al), nickel (Ni)] and some are alloys (brass, bronze, pewter, and steel). • Properties of metals include: shiny, malleable, ductile, a broad range of melting temperatures, and they reflect light that strikes them. • Thermal electrical conductivity of metals is high compared with non-metallic substances.

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Grade 5 - Physical Science Content Standards	Key Knowledge and Concepts from the California Science Framework
1d. *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.	• An element is made of one kind of atom. • Elements are organized on the Periodic Table by their chemical properties (metals, non-metals, etc.). • The physical and chemical properties of an element are determined by the properties of its atoms. • The atomic number is the most important description of an element and can be found on the Periodic Table with the element's symbol and name.
1e. *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.	• Scientific instruments advance knowledge about atoms and properties of molecules and compounds. These instruments include the electron microscope and scanning electron microscope (atomic-resolution instruments). • Atoms are a specific size and shape. • Metallic and crystalline atoms and molecules are arranged in well-ordered arrays.
1f. *Students know* differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.	• Compounds can be separated by their chemical properties (acidity, formation in precipitates, changes in color, melting and freezing point). • Mixtures can be separated by their physical properties (filtering, magnetism, etc.). • Compounds can be identified by their reactions with other compounds (e.g. iodine-starch reaction).

Key Knowledge and Concepts

Grade 5 - Physical Science Content Standards	Key Knowledge and Concepts from the California Science Framework
1g. *Students know* properties of solid, liquid, and gaseous substances, such as sugar ($C_6H_{12}O_6$), water (H_2O), helium (He), oxygen (O_2), nitrogen (N_2), and carbon dioxide (CO_2).	• Solids, liquids, and gaseous substances have specific properties. • Observed chemical properties can be used to describe and identify common elements and compounds such as sugar ($C_6H_{12}O_6$), water (H_2O), helium (He), oxygen (O_2), nitrogen (N_2), and carbon dioxide (CO_2). • Solubility in water, boiling and freezing points, sublimation, and reactivity are some properties of solids, liquids, and gases.
1h. Students know living organisms and most materials are composed of just a few elements.	• The number of types of atoms used as "building blocks" is relatively small. The ways in which atoms are organized into molecules provide the enormous variety of possible compounds, much like the number of words that can be made from only 26 letters. • Living organisms are primarily composed of just a few elements (carbon, oxygen, hydrogen, nitrogen, sulfur, and phosphorus). • Earth's crust consists mostly of oxygen, silicon, aluminum, iron, calcium, sodium, potassium, and magnesium.
1i. *Students know* the common properties of salts, such as sodium chloride (NaCl).	• All salts (i.e. sodium chloride or NaCl), have properties in common. • Salts typically consist of a metallic element and a non-metallic element, and are made when strong acids react with strong bases. • Many salts are hard and brittle with high melting temperatures. Most are soluble in water and when dissolved, they become conductors of electricity. • Many salts are formed by elements in the groups under sodium and magnesium in combination with elements under fluorine on the Periodic Table. • Some salts are poisonous.

K e y k n o w l e d g e a n d C o n c e p t s

Grade 5 - Science Content Standards Investigation and Experimentation	Key Knowledge and Concepts from the California Science Framework
6a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.	• Students classify objects using a set of criteria.
6b. Develop a testable question.	• Students develop a question that can be tested through experimental means.
6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.	• Students plan a simple investigations based on a student-developed question. • Students conduct a simple investigations based on a student-developed question. • Students write procedures that can be carried out by others.
6d. Identify the dependent and controlled variables in an investigation.	• Students identify the dependent variable in an investigation. • Students identify the controlled variable in an investigation.
6e. 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.	• Students identify a single independent variable within an investigation. • Students explain how a single independent variable can be used to collect information. • Students explain how information can be used to answer a question about the results of an experiment.

Key Knowledge and Concepts

Grade 5 - Science Content Standards Investigation and Experimentation	Key Knowledge and Concepts from the California Science Framework
6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.	• Students select tools that are appropriate for what students need to measure. • Students make quantitative observations.
6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.	• Students record data using graphic representations. • Students use graphically represented data to make reasonable inferences.
6h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.	• Students draw conclusions from scientific evidence. • Students determine if more information is needed to support a specific conclusion.
6i. Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions.	• Students write a report of an investigation that includes sections on conducting tests, collecting data or examining evidence, and drawing conclusions.

Grade 5 Physical Science Vocabulary

Additional

- boiling point
- brittle
- chemical
- combination
- comparison
- complexity
- crystalline
- formation
- images
- melting point
- organize
- rearrange
- reflect
- scan
- scientific
- simple
- size
- suspend
- temperature
- unique

Core

- acid
- alloy
- array
- atom
- base
- chemical properties
- chemical reaction
- classifiation
- composite
- compound
- dissolve
- ductile
- electrical thermal-conductivity
- electron
- element
- filer
- freezing point
- gas
- liquid
- malleable
- metallic
- microscope
- microscopy
- mixture
- molecular model
- molecule
- non-metallic
- particle
- Periodic Table
- physical properties
- pressure
- product
- reactants
- salt
- solid
- solubility
- solution
- sublimation
- substance
- symbol

Grade 5 Investigation & Experimentation

- classify
- conclude
- controlled variable
- criteria
- data
- dependent variable
- evidence
- independent variable
- infer
- quantitative

Grade 4 Investigation & Experimentation

- cause-and-effect
- conclusion
- differentiate
- evidence
- inference
- interpret
- investigation
- measure
- multiple trials
- observation
- opinion
- prediction
- record
- result

Elements and their Symbols

- Aluminum (Al)
- Copper (Cu)
- Gold (Au)
- Helium (He)
- Iron (Fe)
- Nickel (Ni)
- Silver (Ag)

Compounds and Molecules and their Symbols

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrogen (N_2)
- Oxygen (O)
- Propane (C_3H_8)
- Salt (NaCl)
- Sugar ($C_6H_{12}O_6$)
- Water (H_2O)

Core Vocabulary - Defined

This *Guide* supports students learning the academic language of science. Sample definitions for each core vocabulary term are provided as a resource. Using the language of science is important to help students learn both the process and the content of science, but simply knowing the definitions of scientific terms is not the same as knowing important science concepts. By giving students the opportunity to use academic language in the greater context of instruction, including oral discourse and a variety of print, students will become comfortable recognizing and using these terms as they do science.

General Terms

acid - A compound, usually water-soluble, with specific properties (reacts with basic solutions and has a pH less than 7).

alloy - A solid mixture of two or more different metals.

array - A group of atoms arranged in a structured way.

atom - The smallest particle of an element that has all the properties of that element.

base - A compound, usually water-soluble, with specific properties (reacts with an acid solution and has a pH greater than 7).

chemical properties - The unique characteristics of substances (elements and compounds) that result from the structure of the kinds of atoms that make up the substances.

chemical reaction - A process that changes the molecular composition of a substance by redistributing atoms or groups of atoms.

classification - The grouping of things by using a set of rules.

composite - Made up of different parts.

compound - When atoms from two or more different elements combine to produce a substance with chemical properties different from the original elements.

dissolve - To become absorbed in a liquid solution.

ductile - The ability of a substance to be pulled or shaped into thin strands without breaking.

electrical and/ or thermal conductivity - The ability of a substance to transmit electricity or heat through the substance.

electron - A subatomic particle with a negative charge.

element - Matter that is composed of only one type of atom and that has the same chemical properties as the individual atoms.

filter - A porous material used to collect specific particles that are passing through the material.

freezing point - The temperature at which a liquid becomes a solid.

gas - A substance, such as air (at ordinary temperatures), that has no definite shape and whose volume will expand to fill a container.

liquid - A substance with a definite volume but without a definite shape.

malleable - A substance (usually metal) that can be bent or shaped without breaking.

metallic - Made of or containing metal (shiny and highly reflective substances).

microscope - A device that uses a system of lenses to magnify an image of an object.

microscopy - The study and design of microscopes; an investigation or observation that involves the use of a microscope.

mixture - A combination of two or more different kinds of matter, with each keeping their own characteristics.

molecular model - An interpretation or visualization of a molecule based on scientific evidence.

molecule - Two or more atoms bonded together, also the smallest particle of a compound (i.e. O_2, H_2O, CO_2, etc.).

non-metallic - Made of, or containing, no metal.

particle - A very small piece of something; any one of the basic units of matter (molecule, atom, etc.).

Periodic Table - A table of elements arranged in a particular order of increasing atomic number; elements grouped by similar chemical properties.

physical properties - The characteristics of an object that can be observed or measured without changing it into something else.

pressure - The application of a firm regular weight or force.

product - The result of a chemical reaction.

reactants - Substances that react with other substances in a chemical reaction.

salt - A chemical compound with certain properties, formed as the result of combining specific metals with specific non-metals.

solid - A substance with a definite shape and volume.

solubility - The ability of a substance to be dissolved.

solution - A substance consisting of two or more substances mixed together and uniformly dispersed, most commonly the result of dissolving a solid, fluid, or gas in a liquid.

sublimation - The process of a solid becoming a gas without passing through the liquid state.

substance - A particular kind of matter or material.

symbol (also Chemical Symbol) - A short (consisting of one or two letters) representation of elements that is used by scientists.

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Grade 5 - Life Science Content Standards	Key Knowledge and Concepts from the California Science Framework
2a. *Students know* many multicellular organisms have specialized structures to support the transport of materials.	• Organisms are made of cells. • Most multi-cellular animals' cells receive food (such as glucose or other sugars) and oxygen, and get rid of waste (such as CO_2) through blood circulation. • Most multi-cellular plants have transport structures to carry water, glucose, and minerals.
2b. *Students know* how blood circulates through the heart chambers, lungs, and body and how carbon dioxide (CO_2) and oxygen (O_2) are exchanged in the lungs and tissues.	• The circulatory and cardiovascular systems are composed of the heart, lungs, arteries, and veins. • The human heart has four chambers that circulate blood throughout the body without mixing oxygen rich blood from the lungs with oxygen poor blood from the body.
2c. *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.	• There are sequential steps for the process of digestion as food moves through the mouth, esophagus, stomach, small intestine, large intestine, and colon. • Each part of the digestive system (mouth, teeth, esophagus, stomach, small and large intestines, and colon) has specific roles.
2d. *Students know* the role of the kidney in removing cellular waste from blood and converting it into urine, which is stored in the bladder.	• There are systems that remove waste from organisms' bodies to prevent cellular poisoning. • Waste products are removed from the blood stream by the kidneys, and stored in the bladder as urine until removed from the body. • In many plants, some waste products are stored in vacuoles within each cell as the cell grows older.

Key knowledge and Concepts

Grade 5 - Life Science Content Standards	Key Knowledge and Concepts from the California Science Framework
2e. *Students know* how sugar, water, and minerals are transported in a vascular plant.	• In vascular plants, the xylem transports water and minerals to where photosynthesis occurs. • Vascular plants use roots and xylem to replace water lost through evaporation. • In vascular plants, the phloem transports sugar from where photosynthesis occurs.
2f. *Students know* plants use carbon dioxide (CO_2) and energy from sunlight to build molecules of sugar and release oxygen.	• Photosynthesis is a plant process for using energy from the Sun to break apart water and carbon dioxide molecules and reassemble their atoms to produce sugar and oxygen. • The equation for photosynthesis is ($6CO_2 + 6H_20 \rightarrow C_6H_{12}O_6 + 6O_2$). Energy for the reaction is provided by the Sun. • The sugar made during photosynthesis is an initial compound that plants use for energy to make all other organic molecules that the plant needs.
2g. *Students know* plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO_2) and water (respiration).	• The process of using sugar and oxygen to produce energy, for both plants and animals, is called cellular respiration. • The equation for cellular respiration is ($C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_20$). This reaction produces energy that both plants and animals need for survival. • Respiration (a more generic term, also called breathing in land animals) is a commonly used term for the process that animals use to exchange gases (exchanging carbon dioxide for oxygen) from the blood in their lungs or gills.

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K e y k n o w l e d g e a n d C o n c e p t s

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Grade 5
Life Science Vocabulary

Core

arteries
atrium
bladder
carbon dioxide (CO_2)
cardiovascular
cells
cellular respiration
chemical reaction
circulation
circulatory system
compound
digestion
heart chambers
kidney
lungs
multicellular organisms
oxygen (O_2)
phloem
photosynthesis
respiration
sugar ($C_6H_{12}O_6$)
vacuole
vascular plant
veins
ventricle
xylem

Additional

by-products
cross-section
energy
exhale
glucose
inhale
reaction
specialized structures
tissues
transport materials
waste

Grade 5
Investigation & Experimentation

classify
conclude
controlled variable
criteria
data
dependent variable
evidence
independent variable
infer
quantitative

Grade 4
Investigation & Experimentation

cause-and-effect
conclusion
differentiate
evidence
inference
interpret
investigation
measure
multiple trials
observation
opinion
prediction
record
result

Core Vocabulary - Defined

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General Terms

arteries - The structures that deliver blood (usually oxygen rich) from the heart to the body.
atrium - An upper chamber of the heart.
bladder - An organ in animals that is used for storing urine.
carbon dioxide (CO_2) - A molecule consisting of two oxygen atoms and one carbon atom.
cardiovascular - A term referring to the heart and blood vessels.
cells - The basic units of structure and function in all living things.
cellular respiration - The process of cells breaking down carbohydrate (sugar) molecules to produce energy.
chemical reaction - A process that changes the molecular composition of a substance by redistributing atoms or groups of atoms.
circulation - The movement of blood through the body.
circulatory system - The system that mostly consists of the heart and blood vessels.
compound - Two or more elements chemically bonded together in specific proportions.
digestion - Processing of food to a form that can be used (nutrients).
heart chambers - The compartments of the heart, separated by valves.
kidneys - The organs that filter waste liquid that is eventually excreted as urine.
lungs - The organs that facilitate the exchange of oxygen and carbon dioxide in many animals.
multicellular organisms - Organisms consisting of more than one cell.
oxygen (O_2) - A colorless, odorless gas with the symbol "O."
phloem - Tubes within a plant that carry food (sugars) from sites of photosynthesis to the rest of the plant.
photosynthesis - The process by which plants produce sugars and oxygen.
respiration - A common term for the process of gas exchange by living organisms in order to facilitate cellular respiration.
sugar ($C_6H_{12}O_6$) - A simple sugar produced in plants by photosynthesis and in animals by the conversion of carbohydrates, proteins, and fats.
vacuole - A structure in plant cells used to store water or waste.
vascular plants - Plants with transportation systems that transport water and sugars (usually with stems and / or leaves).
veins - The structures that carry blood (usually oxygen poor) from the body to the heart.
ventricle - A lower chamber of the heart.
xylem - Tubes within a plant that carry water and minerals to the sites of photosynthesis.

Grade 5 - Earth Science Content Standards	Key Knowledge and Concepts from the California Science Framework
3a. *Students know* most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.	• Water covers 3/4 of the Earth's surface. Most water is present as salt water. • Rain is fresh water. When rain falls on land it dissolves salts and minerals and carries them to the ocean. • Water evaporates from the surface of the Earth. When water evaporates from the surface of the oceans, the salts are left behind.
3b. *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.	• Liquid water on the Earth's surface, warmed by the sun, evaporates and becomes water vapor. When this water vapor cools, it can reappear as a liquid or a solid (condensation). Water falling toward the surface is called precipitation. • Water vapor mixes with the air as the water vapor moves through the atmosphere. • Alternating periods of evaporation and precipitation drive the hydrologic (water) cycle.
3c. *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.	• Atmospheric circulation moves water vapor, which can also be seen as clouds and fog, from one place to another. • When water vapor cools, it forms tiny droplets that can be seen as clouds. Very low clouds are called fog. • When water droplets become large enough to fall, they become rain. When the droplets are cooled below freezing, they fall as hail, sleet, and snow. • The quantity of water vapor in the air is called humidity. Depending on temperature, the water vapor in the air (humidity) can condense and become precipitation.

K e y   k n o w l e d g e   a n d   C o n c e p t s

Grade 5 - Earth Science Content Standards	Key Knowledge and Concepts from the California Science Framework
3d. *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.	• All the water on Earth has existed in other forms. • Water quality is affected by various uses, including the disturbance or development of land. • There are strategies for the management of water resources.
3e. *Students know* the origin of the water used by their local communities.	• Water conservation practices can reduce the amount of water used in their community. • The local water supply has a specific source(s) and pathway as it moves to the community where it is used.
4a. *Students know* uneven heating of Earth causes air movements (convection currents).	• The atmosphere and surface of Earth are heated unevenly. Uneven heating results in local and global pressure and temperature differences. • Warm air rises and cold air falls, setting up convection currents. These convection currents cause local and global winds.
4b. *Students know* the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns.	• Large bodies of water (oceans) can absorb and release great amounts of heat without changing their own temperature. When oceans do change temperature, weather patterns may change (e.g. El Niño Southern Oscillation, or ENSO). Air in contact with large bodies of water is tempered. • Winds carry water vapor to cooler regions, where the water vapor condenses (precipitation). The amount and distribution of precipitation depends on the amount of water vapor in the air and the temperature of both air and water. • The transportation of heat and water globally by oceans (oceanic circulation) moderates global temperatures.

Key knowledge and Concepts

Grade 5 - Earth Science Content Standards	Key Knowledge and Concepts from the California Science Framework
4c. *Students know* the causes and effects of different types of severe weather.	• The source of energy for all weather is the Sun. • The uneven heating of the surface of the Earth causes major storms such as hurricanes, tornadoes, thunderstorms, and monsoons. The effects of these major storms can be devastating. • The relationship between temperature and humidity results in condensation and precipitation (i.e. rain). • When air masses of different temperatures meet, they may create weather fronts. These fronts move as the air masses move and weather can be predicted based on the location of the fronts.
4d. *Students know* how to use weather maps and data to predict local weather and know that weather forecasts depend on many variables.	• Weather data is gathered from many sources and can be used to create weather maps that show temperatures and the location of weather fronts. • Air flows from areas of high pressure to areas of low pressure. • Weather fronts in the U.S. move from west to east and can be used to predict future weather. • There are so many variables that can affect weather that long term weather forecasting is unreliable.
4e. *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.	• Air has mass and the force of gravity acting on that mass (weight) pulls the air toward the Earth's center. • Atmospheric pressure is created by the weight and temperature of the air. • Atmospheric pressure is measured using a barometer, and is usually greatest at lower elevations (where there is more air pressing down), and less at higher elevations (where there is less air pressing down).

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Grade 5 - Earth Science Content Standards	Key Knowledge and Concepts from the California Science Framework
5a. *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.	• The Sun is the central and largest object in our solar system. • The Sun is one million times the volume of Earth, and the amount of matter in the Sun (mass) creates a gravitational attraction between it and the amount of matter (mass) of the planets in our solar system. • The energy from the Sun is created by the fusion of hydrogen to helium.
5b. *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.	• There are nine planets in our solar system, held in place by gravity as they orbit the Sun. • Asteroids and comets are held in place by gravity, but their orbits are usually very different from planets (less circular and more elliptical). • Most planets have moons (natural satellites). Only Earth's moon is visible without a telescope.
5c. *Students know* the path of a planet around the Sun is due to the gravitational attraction between the Sun and the planet.	• Planets move in an elliptical, almost circular, pattern around the sun. • Moons move in an elliptical, almost circular, pattern around planets. • The gravitational attraction (force) is between the amount of matter (mass) of a planet and the amount of matter (mass) of the Sun. This attraction results in planets' orbits around the Sun.

K e y k n o w l e d g e a n d C o n c e p t s

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6d. Identify the dependent and controlled variables in an investigation.	• Students identify the dependent variable in an investigation. • Students identify the controlled variable in an investigation.
6e. 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.	• Students identify a single independent variable within an investigation. • Students explain how a single independent variable can be used to collect information. • Students explain how information can be used to answer a question about the results of an experiment.

Key Knowledge and Concepts

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6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.	• Students record data using graphic representations. • Students use graphically represented data to make reasonable inferences.
6h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.	• Students draw conclusions from scientific evidence. • Students determine if more information is needed to support a specific conclusion.
6i. Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions.	• Students write a report of an investigation that includes sections on conducting tests, collecting data or examining evidence, and drawing conclusions.

Grade 5
Earth Science Vocabulary

Additional

absorption
climate
clouds
conservation
crystallize
dam
distribution
flood basin
fog
glacier
groundwater
hail
humidity
hydrogen
ice
inversion layer
lake
rain
reclamation
recycle
reservoir
resource
runoff
seasonal
sleet
snow
sphere
stream
tempered
water (H_2O)
water demand
water supply
watershed
weather balloon
wind

Core

absorption
altitude
aqueduct
asteroid
atmosphere
atmospheric-
(barometric pressure)
barometer
circular orbit
circulation
comet
condensation
convection currents
currents
dissolve
elliptical orbit
evaporation
forecast
fresh water
front
gas
gravity
hydrologic (water) cycle
latitude
liquid
mass
planet
polar regions
precipitation
radiation
salt water
satellite
solar system
solid
star
sun
temperate region
tropical region
vapor
weather
weight

Grade 5 Investigation & Experimentation

classify
conclude
controlled variable
criteria
data
dependent variable
evidence
independent variable
infer
quantitative

Grade 4 Investigation & Experimentation

cause-and-effect
conclusion
differentiate
evidence
inference
interpret
investigation
measure
multiple trials
observation
opinion
prediction
record
result

Core Vocabulary - Defined

This *Guide* supports students learning the academic language of science. Sample definitions for each core vocabulary term are provided as a resource. Using the language of science is important to help students learn both the process and the content of science, but simply knowing the definitions of scientific terms is not the same as knowing important science concepts. By giving students the opportunity to use academic language in the greater context of instruction, including oral discourse and a variety of print, students will become comfortable recognizing and using these terms as they do science.

General Terms

absorption - The incorporation of a substance or material into another structure, substance, or material (usually greater in size or volume).

altitude - The height of something above a particular level (i.e. above the Earth's surface).

aqueduct - A pipe or channel for moving water.

asteroid - Small and rocky objects that are scattered mainly in a large area between the orbit paths of Mars and Jupiter, moving around the sun.

atmosphere - The layer of gases (air) that surround a planet.

atmospheric (barometric) pressure - A measure of the weight of air particles pressing down on the Earth's surface (caused by gravity).

barometer - An instrument for measuring changes in atmospheric pressure, used in weather forecasting.

circular orbit - The curved route (resembling a circle) of an object around another object (i.e. a planet's orbit around the sun).

circulation - The free movement of air or water from place to place.

comet - An object composed of rock, dust, and ice that orbits the sun in a long, oval-shaped path (elliptical orbit).

condensation - The process by which a gas (i.e. water vapor) loses heat and changes (condenses) into a liquid.

convection currents - Circulatory movement in a liquid (such as water) or gas (such as air), influenced by gravity, that results from regions of different temperature.

currents - The steady flow of water or air in a particular direction.

dissolve - The breaking up into smaller or more basic parts of one substance (commonly a solid) into another (commonly a liquid).

elliptical orbit - The curved route (resembling an ellipse) of an object around another object (i.e. a comet's orbit around the sun).

evaporation - The process of water changing to a gas at the surface of a liquid due to heat (i.e. when warmed by the sun).

forecast - To make a prediction about the future, based on data.

fresh water - Water that may contain small amounts of minerals, but very little salt.

front - Where two different air masses meet, creating a border.

gas - A substance, such as air (at ordinary temperatures), that has no definite shape and whose volume will expand to fill a container.

gravity - The attraction between objects that is affected by the relative distance and mass (the amount of matter) of the objects (i.e. the attraction a celestial body exerts on another celestial body, or on objects at or near the celestial body's surface).

hydrologic (water) cycle - The transferring of water from the Earth's surface to the atmosphere and back again.

latitude - A system of imaginary lines that join points on the Earth's surface, all of equal distance north or south of the equator.

liquid - A substance in a condition in which it flows, that is fluid at ordinary room temperature and atmospheric pressure, and whose shape (but not volume) takes on the same shape as its container.

mass - The amount of matter in an object or particle.

planet - A large object that moves around a star.

polar region - A region on Earth between the latitudes of 60 and 90 degrees (near the Earth's north or south poles).

precipitation - Water in the form of rain, snow, or hail, falling toward the ground (all formed by condensation of water in the atmosphere).

radiation - Energy that is emitted from a source and travels by energy waves without a medium (such as water).

salt water - Water containing salt, such as ocean water.

satellite - Any body or object (like the moon or artificial object) that orbits another body or object in space.

solar system - The sun and all the objects that revolve around it.

solid - A substance with specific dimensions of length, breadth, and depth that resists moderate stress or deformation.

star - A celestial body made of gases that generates energy by thermonuclear reactions.

sun - The star at the center of our solar system around which the Earth and 8 other planets orbit. Through radiation, it provides us with heat and light.

temperate region - A region on Earth between the latitudes of 30 to 60 degrees north or south of the equator.

tropical region - A region on Earth between the latitudes of 0 to 30 degrees north or south of the equator.

vapor - A gaseous substance, moisture, or some other matter (may be visible in the air as mist, clouds, fumes, or smoke).

weather - The condition of the atmosphere at any given moment.

weight - The downward vertical force experienced by an object because of gravity.

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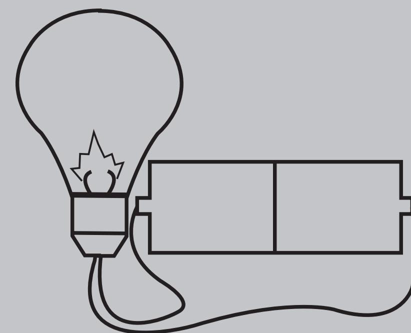
Elementary Science Instructional Guide



Grade 4

Instructional Services Division

Table of Contents

The Elementary Science Instructional Guide is separated into sections to facilitate ease of use. This Table of Contents is a general overview for each section of the document. Each section begins with a detailed Table of Contents.

Foreword

The U.S. Human Genome Project was an effort coordinated by the U.S. Department of Energy and the National Institutes of Health. The project's goals were to identify all of the approximately 30,000 genes in human DNA, determine the sequences of the 3 billion chemical base pairs that make up human DNA, *store* this information in databases, *improve* tools for data analysis, *transfer* related technologies to the private sector, and address the ethical, legal, and social issues that may arise from the project. This was a project that took many years, and thousands of scientists working in coordination, to complete. This is an exemplar of the motto; "You can't do it alone."

The Los Angeles Unified School District recognizes that improved student achievement cannot be accomplished alone. This belief drives all of our actions as we continue to develop a coherent instructional system; everyone is responsible for student learning and student achievement. We share co-accountability and co-responsibility as we strive to close the achievement gap and improve student achievement for all students.

The starting point for an accountability system is a set of content standards and benchmarks for student achievement. Content standards work best when they are well defined and clearly communicated to students, teachers, administrators, parents, and community. The focus of a standards-based education system is to provide common goals and a shared vision of what it means to be educated. The purposes of a periodic assessment system are to diagnose student-learning needs, guide instruction and align professional development at all levels of the system.

The Los Angeles Unified School District is re-designing elementary and secondary instruction. *Putting Students First* is our District's plan to improve the academic achievement of all students.

The primary purpose of this Instructional Guide is to provide teachers and administrators with a "road map" and timeline for teaching and assessing the *Science Content Standards for California Public Schools*. I ask for your support in ensuring that this tool is utilized so students are able to benefit from a standards-based system where curriculum, instruction, and assessment are aligned to support student learning.

We must accept responsibility for eliminating the achievement gap by ensuring **ALL** students have equal access to a rigorous curriculum.

Roy Romer

Superintendent of Schools

MY notes

Overview of Instructional Guide

The *Elementary Science Instructional Guide for Grades 4 and 5* provides a foundation for the teaching of science. Local districts should consider local resources and teacher expertise to plan a meaningful elementary science program for their students while providing a sound foundation for instruction in later grades. This *Guide* is designed to provide an itinerary, a general guide for this journey, based on the more commonly available resources within the District, to assist in the development of an excellent science program.

The *Guide* uses the *California Academic Content Standards in Science* (1998), the *California Science Framework* (2003), and blueprints for the Grade 5 California Standards Test as source documents to guide the development of this publication. As an integral component of the Los Angeles Unified School District's Elementary Periodic Assessment Program, this *Guide* aligns the Academic Content Standards, Framework, District-adopted textbook program, other supplemental materials, assessments, research-based and research-validated instructional practices, and professional development to provide a coherent structure for teaching and learning in the core science program.

> *"Let us remember that education is the road out of poverty, the best weapon against racism, the best correlate to good health, and vital to the continued growth of our economy. Dr. Martin Luther King spoke about the need for greater accountability - a guarantee that all Americans enjoy a full measure of the promise of the American dream... I believe that No Child Left Behind is the logical next step, for it extends educational equity to all Americans. The American Dream begins with, and demands, a meaningful, sound education."*
> *- Secretary of Education, Rod Paige (2003)*

Introduction

In order to evaluate programs and determine students' proficiency in knowing the content called for by the California Academic Content Standards, the state has established the Standardized Testing and Reporting (STAR) Program, of which the California Standards Tests (criterion-referenced assessments aligned to the California Academic Content Standards in English, mathematics, science, and history-social science) are a component. The California Standards Test (CST) program began in 1999 and now has assessments in English and mathematics (grades 2-11), science (grades 9-11), and history-social science (grades 8, 10 and 11). A new test, the Grade 5 CST in science, given for the first time in 2004, is aligned to the grades 4 and 5 California science standards. In 2007 there will be a test in Grade 8 assessing the Grade 8 science content standards, and a test at Grade 10 assessing the Grade 6-8 Life Science and high school Biology / Life Science standards.

The STAR Program is used by California to meet some of the requirements of the No Child Left Behind (NCLB) Act (PL 107-110), signed into law in January 2002. The Federal NCLB Legislation specifies a timeline that requires states to adopt either grade-level content standards, or grade-level content objectives aligned to benchmarked standards in English, mathematics, and science. Once these content standards or grade-level content objectives are adopted, states must phase-in assessments aligned to their adopted content standards or

My notes

objectives. The NCLB science requirement specifies that by the 2007-08 school, year states should give standards-aligned assessments in science at least once in the grade spans 3-5, 6-9, and 10-12. The results of these assessments, as well as those in English, mathematics, and history-social science, will become part of California's accountability program. Components of our state's accountability program are used each year as one of several indicators for schools' and districts' Adequate Yearly Progress (AYP) required by NCLB. Schools, districts, and states that don't meet their AYP targets may face Federal sanctions under the NCLB Act.

The purpose of this *Instructional Guide* and the accompanying *Periodic Assessments* is to provide teachers with the support needed to ensure that students have received the science content specified by the California Academic Content Standards in science, and to provide direction for instruction or additional resources that students may require in order for students to become proficient in science at their particular grade level. This *Guide* is intended to be the foundation of a standards-based instructional program in science.

> *"The bottom line is that there is just no way to create good schools without good teachers. Success in any aspect of reform - whether creating standards, developing more challenging curriculum and assessments, implementing school-based management, or inventing new model schools and programs - depends on highly skilled teachers."*
> *- National Commission on Teaching and America's Future*

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- Reflection
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Periodic Assessment - Blueprint and Sample Items
Vocabulary for the Module
Core Vocabulary Defined
Immersion Unit *

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Units of Instruction

Articulation with topics from prior grade levels and middle school topics
Background information for the teacher
Vocabulary for the Module
List of published resources for each unit of instruction
List of standards alignment for each published resource
Optional additional lessons to support implementation of the *Harcourt* Program

Appendix →

Resources to support implementation of the Instructional Guide including materials cited in the Overview

* Immersion Units are currently in development for each instructional module as a part of the SCALE Partnership, funded by NSF. The storyline for one Immersion Unit is provided in this *Guide* with additional materials forthcoming.

Acknowledgements

The Science Instructional Guide for Elementary Grades 4 and 5 represents the work of many dedicated educators. There is great appreciation for the time spent planning, organizing, and providing the research-based strategies and validated best practices contained within it. The *Guide* is designed to assist educators in implementing instruction and assessment practices that support student achievement for all of our students.

On behalf of all the educators and students who will benefit from your generous contributions, the Los Angeles Unified School District thanks the following individuals and groups.

Science Design Team Members

We thank the Design Team Members who are teachers representing grade levels 4 and 5 and each local district: **Local District A:** Anel Perez, Cathy Paulson, Don Lively, Ellen Irshay, Emilio Lozano, Kristin Ulrich; **Local District B:** Joane Harvin, Kelly Duffy, Olimpio Ramos, Parrish Shiga, Will Rhodes; **Local District C:** Amylynn Robinson, Carol Hakobian, Rhoda Ekmekji, Sibyl Sperber, Sangeeta Maithel, Sheryl Kampelman; **Local District D:** Debbie Breeding, Jacki letierrr, Karen James, Tonya Mandl; **Local District E:** Patricia Leon, Susan Wright, Vasthi Calvache; **Local District F:** Lisa Vargas, Marvilla Bonilla, Susanna Ha, Veronica Vega; **Local District G:** Annie Rinaldi, Celeste Robertson, Edgardo Olivares, Geraldine Gibbs, Jennifer Tochez, Lanelle Harvey, Maryann Richard, Olivia Fields, Susan Singh, Patricia Atlow; **Local District H:** Brandon Scully, Kate Kahler-Rickman, Steve Rittenhouse; **Local District I:** Melissa Burns, Niane Greene; **Local District J:** Grace Nimnualrat, Juliet Ethiryeerasingam; **Local District K:** Kathleen Samms, Keri Porter, Kimberley Vladovick, Loa Caudill, and Glen Isomoto.

Advisory Panel Members

We also thank the Advisory Panel Members representing each local district: **Local District A** - Stephen Bluestein, **Local District B** - Janet Howard, **Local District C** - Emily Taitz, **Local District D** - Suzanne Patterson-Jones and Linda Wooten, **Local District E** - Thomas Yee, **Local District F** - Diane Watkins, **Local District G -** Antonio Pierola, **Local District H** - Sally McGuire, **Local District I** - Gary Scott, **Local District J** - Carol Takemoto, and **Local District K** - Gilberto Samuel.

LAUSD Central Office

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Particular gratitude is extended to Stacy Sinclair-Tarr, the primary developer of this *Guide*. Her tireless effort given on behalf of the students in the Los Angeles Unified School District will always be appreciated.

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Deputy Superintendent, Instructional Service

Grade 4 Earth Science

MY notes

Introduction

In Grade 4 Earth science, students study rocks, minerals, and the processes of weathering and erosion. Their study of these processes connects to their study of the formation of sedimentary rocks, laying a foundation for the understanding that the Earth's surface is constantly changing. Some of these changes happen quickly and other changes happen slowly.

The California Content Standards in Science were designed to spiral the content so that topics introduced in Grades K-3 are presented with increasing depth and complexity in Grades 4-5, 6-8, and again in Grades 9-12. Each time the topic spirals, students can draw upon what they learned before and add to their understanding of the world around them. In Grades K-5, students develop an understanding of what a system is, so that in Grades 6-8 they can focus on how these systems interact.

Articulation: In Grade 2, students were introduced to rocks as a component of the Earth's crust. They learned that rocks have different and distinct properties, and that rocks are made of many different types of minerals. They learned that smaller rocks come from the breaking and weathering of larger rocks, and that soil is made partly from weathered rock.

The content for Grade 4 deepens students' understanding of previously learned material, and prepares them for deeper study in Grade 6 of the formation of the Earth's crust, including rocks and the physical and chemical weathering processes that drive the geologic cycle.

This module of the *Instructional Guide* is designed to provide teachers with a variety of resources to support implementation of the Grade 4 Earth science content standards. The module is organized into sections:

- The content standards
- Vocabulary
- Periodic Assessment
- Immersion unit
- Units of instruction
- Module Planning Calendar

The content standards – All Earth science and Investigation and Experimentation standards are supported in this module. A list of the standards is provided in the document *Key Knowledge and Concepts*. In this document, each standard is described by its major concepts as explained by the *2003 California Science Framework*. The following units of instruction include a list of the specific standards supported by that unit. The same standard may be supported by more than one unit, as many standards are multifaceted and should be addressed through a variety of contexts.

Vocabulary – The module provides a list of all vocabulary for Grade 4 Earth science. Each unit of instruction also includes a vocabulary list in graphic form, depicting the terminology supported by that unit. This *Guide* supports students' acquisition of the language of science. **It should be noted that although vocabulary is important to learning the language of science, knowing the definitions of scientific terminology is not the same as knowing the science concepts.**

Each vocabulary list is divided into three major sections: Core, Additional, and Investigation and Experimentation. <u>Core Vocabulary</u> refers to terminology all students should master as a result of instruction. <u>Additional Vocabulary</u> refers to terms that some students may not yet know, such as those who did not

My notes

have a standards-based science program in Grades K-3. The Investigation and Experimentation (I&E) Vocabulary includes terms from both Grades 4 and 5. Teachers can introduce ideas to be mastered in Grade 5 while developing an understanding of the processes to focus on during Grade 4.

Immersion Unit - The Immersion Unit for Grade 4 Earth science is under development. It will be provided upon completion.

Units of Instruction – The units of instruction for Grade 4 Earth science include: *Rocks and Minerals, Earth's Surface Constantly Changes,* and *Water Erosion*. Each unit introduction explains the focus for the unit, the content standards supported, and teacher background. Each unit includes a listing of the standards, published resources, and vocabulary that relate to the unit. Published resources are provided in two formats. The first chart shows the resources from the *Harcourt Science* text and any needed additional lessons in the left column, and a list of supplemental programs listed by topic on the right. The second chart lists each resource by publisher, with page-specific standards alignment and teacher notes. **These charts provide an extensive list of resources to support instruction of the content. It is not expected that teachers will use all the resources but will choose from those provided as a foundation for teaching the content in the standards.**

Additional Lessons – Those teachers who are using the *Harcourt Science* program will need to supplement their program to ensure that students have access to all the content in the standards. Teachers may choose from the supplemental resources provided on the Resources Chart, or the *Immersion Unit* to provide this needed support. Recognizing that not all supplemental resources are accessible to all classrooms, the specific content and skills that need additional support have been organized into lessons and are provided in this *Guide*. Within the Grade 4 Earth Science Module, all units include additional lessons.

Module Planning Calendar – A planning calendar is provided to assist teachers in mapping out their use of instructional resources including the *Immersion Unit*, *Harcourt Science*, and other supplemental materials as selected. For each week of instruction, space is provided to list the name of the unit of instruction, selected resources, and potential assessments to be used. It is recognized that science may not be taught each day, but rather shorter or longer time blocks may be organized to better fit with the teacher's overall instructional schedule. Space is provided to reflect this flexibility in scheduling instruction, yet also to give the teacher an overview of the instructional module to ensure that students have access to all the content in the standards prior to implementation of a periodic assessment.

Background

When students take the California Standards Test (CST) in Grade 5, the test will include each of the Grade 4 standards in addition to all but one of the Grade 5 standards (standard 3e). In examining the test blueprint, seven (7) items on the test will be aligned with the Grade 4 Earth science standards. Since all standards will be tested with at least one question, students should have a foundational understanding of the content in each of the Grade 4 Earth science standards.

"If you have knowledge, let others light their candles with it."

- Winston Churchill

Grade 4 - Earth Science Content Standards	Key Knowledge and Concepts from the California Science Framework
4a. Students know how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).	• The process of rocks changing from one form to another is called the rock cycle. • Rocks are classified into three major groups by how they are formed: igneous, sedimentary, and metamorphic. • Observable properties are used to identify and distinguish between igneous, sedimentary, and metamorphic rocks.
4b. 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.	• Rocks are made from one or more minerals. • Common ores and minerals can be identified by properties of hardness, cleavage, color, and streak. • Some properties (hardness, cleavage, color, and streak) are used within a table of diagnostic properties (Mohs Hardness Scale) to identify common ores and minerals.
5a. 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.	• Earth's land surface constantly changes. • Some reshaping processes are slow and some are rapid.
5b. Students know natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.	• Rocks break down into smaller pieces. • Rocks are broken down through physical and chemical processes such as erosion, weathering, and the effects of the growth of plants.
5c. 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).	• Landforms are reshaped by water erosion and weathering. • Water erosion is one process that reshapes the land.

Grade 4 - Science Content Standards Investigation and Experimentation	Key Knowledge and Concepts from the California Science Framework
6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.	• Students can differentiate between observation and inference. • Explanations come from observations and the interpretation of observations.
6b. Measure and estimate the weight, length, or volume of objects.	• Students know what weight, length, and volume represent. • Students know how to measure and estimate the weight, volume, and length of objects.
6c. Formulate and justify predictions based on cause-and-effect relationships.	• Students know what cause-and-effect relationships are. • Students can make and justify predictions using cause-and-effect principles.
6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.	• Students will be able to perform multiple experimental trials. • Students know the difference between a prediction, a result, and a conclusion. • Students can use the results of multiple trials to test a prediction and draw conclusions.
6e. Construct and interpret graphs from measurements.	• Students can use measurements to construct a graph. • Students can interpret graphs.
6f. Follow a set of written instructions for a scientific investigation.	• Students can follow a set of written instructions to perform a scientific investigation.

Grade 4 Earth Science Vocabulary

Additional

agent
alternate
alter
carbon dioxide (CO_2)
cemented
chemical weathering
combination
composition
core
crust
diagnostic
expand
fragment
grains
ice
identify
interact
land surface
layers
mantle
molten
oxygen (O)
parent rock
physical weathering
processes
property
rapid
sediment
soil
solidify
temperature

Core

abrasion
creep
crystalline
deposition
dissolve
earthquake
erosion
faults
flood
freezing
geologist
igneous rock
landform
landslide (mass movement)
lava
magma
metamorphic rock
mineral
natural process
ore
rock
rock cycle
sedimentary rock
specimen
thawing
transport
volcano
volcanic eruption
weathering

Size Terms

boulder
cobble
pebble
sand
silt
clay

Names of Common Minerals

calcite
feldspar
galena
hematite
hornblende
mica
quartz

Properties of Rocks & Minerals

cleavage
hardness
luster
metallic
non-metallic
streak

Grade 4 Investigation & Experimentation

cause-and-effect
conclusion
differentiate
evidence
inference
interpret
investigation
measure
multiple trials
observation
opinion
prediction
record
result

Grade 5 Investigation & Experimentation

classify
conclude
controlled variable
criteria
data
dependent variable
evidence
independent variable
infer
quantitative

My notes

Core Vocabulary - Defined

This *Guide* supports students learning the academic language of science. Sample definitions for each core vocabulary term are provided as a resource. Using the language of science is important to help students learn both the process and the content of science, but simply knowing the definitions of scientific terms is not the same as knowing important science concepts. By giving students the opportunity to use academic language in the greater context of instruction, including oral discourse and a variety of print, students will become comfortable recognizing and using these terms as they do science.

General Terms

abrasion - The process of wearing away by friction
creep - The slow movement of soil downhill due to gravity.
crystalline - Relating to, made of, containing, or resembling a solid with regular, repeated and geometrically arranged internal patterns of atoms or molecules.
deposition - The process of sediment being left in a new location.
dissolve - When one material forms a solution with another material.
earthquake - A rapid process by which the shaking of the ground is caused by a sudden release of energy from movement in the Earth's crust.
erosion - A slow process of moving sediments from one place to another by either wind, water, ice, or some combination of these factors.
fault - An area of weakness or a crack in the Earth's crust.
flood - Water that has overflowed from a source such as a river, onto a previously dry area.
freezing - When liquid cools to form a solid; for example, the process of water freezing to form ice.
geologist - A scientist who studies the rocks and minerals of the Earth's crust.
igneous rock - Rock that has formed from molten magma or lava that has cooled to form a hard rock, usually without layers.
landform - The physical features on the Earth's surface.
landslide - The quick movement of dry soil downhill due to gravity.
lava - Melted (or liquid) rock when it flows out of a volcano.
magma - Melted (or liquid) rock within the Earth.
metamorphic rock - A rock that changes its texture and form due to great heat and/or great pressure.
mineral - A naturally occurring crystalline, inorganic solid with a definite chemical composition.
natural process - A process that occurs without the direct influence of humans.
ore - A mineral deposit (usually metallic) that can be mined for profit.
rock - A solid mixture of more than one mineral.
rock cycle - The process by which rocks change from one type to another over time.
sedimentary rock - A rock formed by lithification (a process by which many layers or grains of sediments under pressure eventually form rock).
specimen - Something that is representative because it is typical of its kind, or serves as an example.
thawing - To melt, defrost, or make warm enough that water changes from a solid to liquid state.
transport - The movement of particles by water or wind.
volcano - A structure or mountain formed by the eruption of lava and ash at an area of weakness in the Earth's crust.
volcanic eruption - The process of lava and/or gases leaving a volcano.
weathering - When Earth's surface materials are broken apart either physically, chemically, or through some combination of the two processes into soil, sand, silt, and mud.

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Size terms

boulder - A large rock greater than 200 mm in diameter.
cobble - A rock fragment between 64 and 256 mm in diameter.
pebble - A rock fragment with a diameter between 4 and 64 mm in diameter.
sand - A sediment smaller than a pebble, larger than silt.
silt - A sediment smaller than sand, larger than clay.
clay - A find-grained material smaller than silt.

Properties of Rocks and Minerals Terms

cleavage - The splitting of minerals or rocks along natural planes of weakness.
hardness - The mineral's ability to resist being scratched.
luster - A property of a mineral that describes the way the surface reflects light.
metallic - Made of, containing or consisting of a metal; typically shiny and reflective.
non-metallic - Not containing or consisting of metal; typically neither shiny nor reflective.
streak - The color of the powder left behind when rubbing a mineral against a porcelain tile.

MY notes

Periodic Assessment

As an integral element of the *Elementary Periodic Assessment Program*, the Grade 4 science assessments are designed to provide teachers and the LAUSD with the diagnostic information needed to ensure that students have received instruction in the science content specified by the California Academic Content Standards, and to provide direction for instruction or additional resources that students may require in order for students to become proficient in science at their particular grade level.

Results from the *Periodic Assessments* should be used to inform immediate adjustments and guide modifications in instruction to assist all students in meeting or exceeding the content specified by the state's science content standards.

Calendar

At the conclusion of this *Instructional Unit*, students will take a *Periodic Assessment*. This assessment of the students' accomplishment of the standards within the science discipline should not be considered the sole method of assessing students' content knowledge for this unit.

Each *Periodic Assessment* will consist of multiple-choice and possibly open response questions. Each of the three annual assessments will be scheduled within a testing window at approximately 10-week intervals. A calendar for assessment administration will be made available at the beginning of the academic year. Schools can choose the order of assessment implementation to reflect the order in which the science *Standard Sets* are taught. In making this decision, consider the local issues regarding materials use and storage and needs for professional development.

Blueprint

The following *Periodic Assessment* blueprint shows the design for the Grade 4 Earth science *Periodic Assessment*. The assessment will consist of 25 questions, with 10% of the questions assessing the Investigation and Experimentation standards. The remaining items will assess student knowledge of the Earth science content standards. This blueprint was developed to reflect the focus of the Elementary California Standards Test at Grade 5 in which almost all standards (Grades 4 and 5) are assessed.

Periodic Assesment Blueprint

Standards	# Items
4. The properties of rocks and minerals reflect the processes that formed them. As a basis for understanding this concept:	9 items
4a. Students know how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).	5
4b. 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.	4
5. Waves, wind, water, and ice shape and reshape Earth's land surface. As a basis for understanding this concept:	13 items
5a. 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.	5
5b. Students know natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.	4

PA

MY notes

Standards	# Items
5c. 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).	4
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:	3 items
6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.	✓
6b. Measure and estimate the weight, length, or volume of objects.	
6c. Formulate and justify predictions based on cause-and-effect relationships.	
6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.	
6e. Construct and interpret graphs from measurements.	
6f. Follow a set of written instructions for a scientific investigation.	
Total Items	**25**

Sample Items

Rocks and Minerals

The purpose of these sample items is to serve as a tool to assist classroom teachers in assessing student knowledge of specific science content aligned with the *Science Framework for California Public Schools: Kindergarten Through Grade Twelve*. This content can be assessed through a variety of assessment tools.

Multiple Choice

These examples are designed to assess students' knowledge of Grade 4 standard 4b. "*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." The examples show a range of difficulty and can be used to give students practice in responding to rigorous multiple choice questions.

Reference Sheet

Mohs Hardness Scale	
1	Talc
2	Gypsum
3	Calcite
4	Fluorite
5	Apatite
6	Orthoclase / Feldspar
7	Quartz
8	Topaz
9	Corundum
10	Diamond

1. Which of the following minerals can scratch Corundum? **B**
   A. Gypsum
   B. Diamond
   C. Talc
   D. Topaz

P A

2. Scientists sometimes use a penny with a hardness of 3, or glass with a hardness of 6, to test a mineral's hardness. Which of the following minerals could be scratched by glass but *not* by a penny? **A**
   A. Apatite
   B. Quartz
   C. Talc
   D. Gypsum

Question #1 requires students to have a basic familiarity with Mohs Hardness Scale. To answer this question, students must understand that to scratch Corundum, the selected mineral must be harder, and therefore have a higher number on Mohs Scale than Corundum.

Question #2 requires students to proceed through multiple thought processes to arrive at the selected answer. In order to answer the question students must be familiar with reading charts such as Mohs Hardness Scale. First, students examine the chart to relate the hardness of a penny with Calcite and the hardness of a glass with Orthoclase. Next, using the context of the question, the student determines that the question is asking for the student to identify which mineral is softer than Orthoclase and harder than Calcite. Third, the student finds which of the listed minerals meet the criteria for selection.

If these items were on a *Periodic Assessment*, teachers would receive a *Sample Answer Sheet Rationale* that is aligned with these questions. The following shows how these questions would be represented on the *Sample Answer Sheet Rationale*.

Sample Answer Sheet Rationale

Question Number on Live Test	Content Standard	Correct Answer Choice	Description of Distracters
1	4b	B	(a) Gypsum is much softer than Corundum. (b) Diamond is the only mineral listed harder than Corundum. (c) Talc is the softest mineral listed. (d) Topaz is slightly softer than Corundum.
2	4b	A	(a) Apatite can be scratched by Orthoclase but not by Calcite. (b) Quartz is harder than Orthoclase and Calcite. (c) Talc is softer than Orthoclase and Calcite. (d) Gypsum is softer than Orthoclase and Calcite.

Open Response

The district *Periodic Assessments* may include open response items.

In the classroom, teachers have a variety of assessment tools to choose from in order to best capture students' understanding of the content. Below are sample open response items that could be used instead of, or in combination with, multiple choice items to assess students' knowledge of the same content standard (Grade 4: 4b) as well as Investigation and

My notes

Experimentation (I&E) standard 6b. “Measure and estimate the weight, length, or volume of objects.”

Open response questions are challenging for students. Teachers may want to scaffold the implementation of these tools depending on the needs of students. Teachers may begin by working with students to develop concept maps to depict the ideas that should be included in an appropriate answer. Students can then use the graphic organizer to develop their response. In time, students will be able to develop these graphic organizers in cooperative groups and independently.

Teachers using open response items should develop rubrics to assist in the scoring of student work. The *LAUSD Generic Scoring Guide for Written Product: Science* (see Appendix, page 40) may be helpful in the development of these rubrics.

Properties of Some Common Minerals

Sample	Hardness	Color	Luster	Streak	Special Attributes
Calcite	3	Colorless, white	Non-metallic	White	Reacts to acid
copper	3	Reflective, deep yellow	Metallic	None	
Feldspar	6	Colorless, pink, beige	Non-metallic	None	
Galena	2.5 - 3	Grey	Metallic	Grey	Heavy for its size
Hematite	5 - 6.5	Gray or red	Metallic or non-metallic	Reddish - brown	
Hornblende	5 - 6	Dark green to black	Non-metallic	None	
Mica	2 - 2.5	Brown to black or silver - white	Non-metallic	None	Flakes when peeled
Quartz	7	Variety	Non-metallic	None	

Question 3: If you were given two sample minerals, one quartz and the other calcite, how would you tell them apart?

The students’ response should include the following:

- Students may perform a series of tests including a hardness test. Scratch one against the other. The one that cannot be scratched is quartz.
- A second test should be done to confirm the identity of the mineral samples. Examination of cleavage angles would confirm the sample’s identity, as a calcite crytal forms a parallelogram. Quartz has a concoidal fracture [note: the type of fracture is beyond the standard and provided only for the teacher] and does not exhibit cleavage.

MY notes

Question 4: How you would explain to another student how to identify a mineral sample?

The students' response should include the following:

- The response should explain how to perform at least two (2) tests to confirm the identity of the mineral and how to use the diagnostic chart (provided) to assist in the identification process.
- In addition to explaining the tests to perform, the student would caution against relying on color, as mineral color may be inconsistent.
- A variety of tests can be performed on a mineral sample to determine its identity. Tests that the student may reference include:
  - Scratch test – to determine the relative hardness of the sample;
  - Observation for luster – determine if the sample is metallic or nonmetallic;
  - Observation for color – identify the color of the sample;
  - Streak test – to determine the color of the sample's streak;
  - Acid test – drop vinegar on the sample to determine if it reacts to acid;
  - Flake test – try to break a small piece off the sample to determine if the sample will flake into thin layers;
  - Measurement – if there is more than one sample provided, the relative weights can be compared;
  - Cleavage – to determine the shape of the crystalline structure;
  - Fracture – how the sample breaks into smaller pieces;
  - Use of a reference sheet of diagnostic properties to determine the probable identify of the sample, based on the tests performed.

Sample Items — Investigation and Experimentation (I&E)

Multiple Choice

The following examples are designed to assess students' knowledge of standard 6a. "Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations." The examples show a range of difficulty and can be used to give students practice in responding to rigorous multiple choice questions.

5. The relative age of a grain of sand on a beach could be determined by ____ **A**

   A. examining the shape and size of the grain of sand.
   B. matching the color with surrounding rocks.
   C. identifying the type of rock it comes from.
   D. measuring the power of the waves on the beach.

6. Northern California has a strong agricultural economy because ___ **C**

   A. there is plenty of water.
   B. high winds bring nutrients.
   C. the Sacramento delta makes nutrient-rich soil accessible.
   D. the population of the state is so large.

P
A

MY notes

Question #5 requires that students use prior observations to infer the relationship that exists between the physical characteristics of a grain of sand and the length of time required for the grain to acquire these characteristics, given the students' knowledge of the processes of erosion and weathering.

Question #6 asks students to infer the relationship between the presence of rich soil needed to support a healthy agricultural industry and the way water carries nutrients through rivers and streams to flat plains. The context for this question connects with students' understanding of the Grade 4 history – social science standard 4.1.3. "Identify the state capital and describe the various regions of California, including how their characteristics and physical environments (e.g., water, landforms, vegetation, climate) affect human activity."

If these items were on a *Periodic Assessment*, teachers would receive a *Sample Answer Sheet Rationale* that is aligned with these questions. The following shows how these questions would be represented on the *Sample Answer Sheet Rationale*.

Sample Answer Sheet Rationale

Question Number on Live Test	Content Standard	Correct Answer Choice	Description of Distracters
5	6a	A	(a) The answer is correct. (b) Sand color is the same when the grains come from the same source. (c) Identifying the type of rock does not aid in determining the age of the sand grain. (d) Wave power can influence how much the sand will rub against other grains, but most sand on the same beach will have experienced these same conditions. The issue is how long the grain of sand has experienced this condition, which cannot be determined by consistent wave action.

Question Number on Live Test	Content Standard	Correct Answer Choice	Description of Distracters
6	6a	C	(a) Fresh water for irrigating crops is limited and must be used carefully. (b) High winds blow topsoil away from the flat areas used for growing fields. (c) The answer is correct. (d) The population of California can help in the maintenance and harvest of crops, but this population is not the reason for the rich soil. Often, building to house and service the population results in the destruction of potential farmland.

Open Response

In the classroom, teachers have a variety of assessment tools to choose from in order to best capture students' understanding of the content. Below are sample open response items that could be used instead of, or in combination with, multiple choice items to assess students' knowledge of the same I&E standard (6a) as well as provide a context from the discipline standards.

Question 7: You are given a sample of sedimentary rock (sandstone) and igneous rock (granite). What observations would distinguish between how each of these was formed?

MY notes

The students' response should include the following:

- The sandstone may be composed of small, rounded pieces.
- The sandstone may have layers.
- The granite looks like crystals that grew together like a jigsaw puzzle.
- Evidence for formation:
  - visible grains imply that the rock was formed from sediment;
  - crystalline structure implies that the rock was formed from molten material.

Question 8: Although rain does not have any minerals in it, why are there large concentrations of a few minerals in rivers, lakes and in the ocean?

The students' response should include the following:

- When rain falls on rocks and soil, chemical weathering separates minerals from the rocks and transports these minerals to rivers, lakes and finally the ocean.
- Ice, flowing water, and wind may mechanically break rocks into smaller and smaller pieces over time and distance, and transport them as sediment.
- The most common minerals found in water include sodium, calcium, magnesium, and iron.

P
A

Rocks and Minerals

MY notes

The *Rocks and Minerals* unit is focused on students' ability to observe rock and mineral samples and to distinguish between the samples using clearly defined physical properties. Rocks are classified based on how they are formed (igneous, metamorphic, sedimentary). Minerals are classified based on their chemical composition and resulting physical properties (color, hardness, streak, cleavage, fracture, and luster).

The first distinction for students is to understand the difference between rocks and minerals. Minerals have a very specific definition. Minerals must be naturally occurring (e.g. ice on the pond is a mineral, ice in your refrigerator is not). Minerals must never have been alive, and are also called abiotic or inorganic minerals (e.g. pearls and coal come from organic sources so they are not minerals). Minerals must be a crystalline solid and must have a consistent chemistry. Rocks on the other hand, do not have such a formal definition. Rocks are "made of more than one mineral." Almost anything hard is a rock if it does not meet the criteria for a mineral.

Across Los Angeles there are many resources to support an enriched study of rocks and minerals. The city's museums house quality collections, and the mountain ranges and beach areas that border the city provide a rich source for examining and collecting samples. For a list of district-approved field trips and assemblies, review LAUSD publication GC-148, pg. 35-67. This publication also includes necessary LAUSD bulletins on transportation, safety, and other issues related to field trip excursions.

California Academic Content Standards – This unit focuses on content standards 4a and 4b, with significant support for building science process skills in the I&E standards 6a – 6f.

California Academic Content Standards:

4a. Students know how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).

4b. 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.

6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6b. Measure and estimate the weight, length, or volume of objects.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

6e. Construct and interpret graphs from measurements.

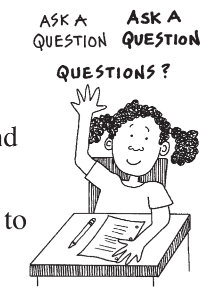
6f. Follow a set of written instructions for a scientific investigation.

Vocabulary – The core vocabulary for the *Rocks and Minerals* unit focuses on properties of rocks and minerals, types of rocks, and how rocks are formed. Additional vocabulary reflects terminology students may have been introduced to in Grade 2 and terms that they will become familiar with as a result of rock and mineral identification activities. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons – The additional lessons for this unit are: *Mineral Identification Lab* and *Rock Identification Lab*.

MY notes

Critical Questions



- How are rocks and minerals formed?
- How are rocks and minerals distinguished and how are they classified?
- How does understanding the rock cycle help to explain the classification of rocks?

Connections

The following are optional connections that can be made across the curriculum. Specific standards citations for these connections can be found in the publisher's materials chosen for instruction.

Language Arts: Students learn a number of vocabulary terms in this unit. As a part of this study, students find that in science, terms may have different meanings than they have in common language (e.g. *fracture, cleavage*).

Mathematics: Students reinforce their understanding of parallel and perpendicular lines. They practice identifying geometric shapes, and may practice finding the volume of irregularly shaped objects. Students estimate and measure the length and weight of rock samples.

History-Social Science: As students become familiar with common rocks and minerals, they make connections to those rocks and minerals commonly found in geographic regions of California.

Background

The following information is intended to assist with areas where alternate conceptions of the content can occur.

- When students take the California Standards Test (CST) in Grade 5, the test will include each of the Grade 4 standards in addition to Grade 5 standards. Students will be given a reference sheet to use when they take the test. This reference sheet will include Mohs Hardness Scale and a Chart of Diagnostic Properties. This reference sheet reinforces the message from the *California Science Standards* and *Framework* that students should know how to <u>use</u> a chart of diagnostic properties, not memorize it.
- Students can be given a selection of mineral samples to identify. By identifying the sample's hardness, color, luster, and streak, the sample can be identified.

Rock samples can be used to provide students with practice in differentiating between weight and volume. Samples can be put on a balance to determine their weight. By submerging samples in a graduated cylinder and computing the before and after difference in volume, the volume of irregular-shaped samples can be determined. Through activities such as this, students will practice Standard 6b and extend their knowledge of finding the volume of an object, an extension of the skills introduced in Grade 3 (Mathematics: Measurement and Geometry 1.1) in preparation for Grade 5.

> *"There is one thing even more vital to science than intelligent methods; and that is, the sincere desire to find out the truth, what-ever it may be."*
>
> *- Charles Sanders Pierce*

Grade 4 Vocabulary
Rocks & Minerals

Core

crystalline
geologist
igneous rock
lava
magma
metamorphic rock
mineral
natural process
ore
rock
rock cycle
sedimentary rock
specimen

Additional

composition
core
crust
diagnostic
expand
fragmented
grains
layers
mantle
molten
oxygen (O)
parent rock
processes
sediment
soil
solidify
temperature

Properties of Minerals

cleavage
hardness
luster
metallic
non-metallic
streak

Common Minerals

calcite
feldspar
galena
hematite
hornblende
mica
quartz

Investigation & Experimentation

Grade 4

cause-and-effect
conclusion
differentiate
evidence
inference
interpret
investigation
measure
multiple trials
observation
opinion
prediction
record
result

Grade 5

classify
conclude
controlled variable
cri teri a
data
dependent variable
evidence
independent variable
infer
quantitative

California Academic Content Standards:

4a. Students know how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).

4b. 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.

6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6b. Measure and estimate the weight, length, or volume of objects.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

6e. Construct and interpret graphs from measurements.

6f. Follow a set of written instructions for a scientific investigation.

My notes	HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL * Resources are organized by topic		My notes
	RESOURCE	NOTES	RESOURCES	NOTES	
	Chapter 2 • Lesson 1, *What are Minerals?* pg. B34-39 • B57 Investigative Challenge	• *Mineral Properties*, pg. B34-35, nail and fingernail can be confusing on Hardness Scale. Use a push pin or blunt knife instead of nail. • Emphasize definition of a mineral over mineral formation. • Streak is used only for metallic minerals. • Minerals listed are too close to each other and will not clearly show effect. Use Quartz instead of Calcite.	**Mineral and Rock Identification** FOSS: Earth Materials, • Activity 1: *Mock Rocks*, pg. 1-9 • Activity 4: *Take it for Granite*, part 1, pg. 6-7 GEMS: *Stories in Stone*, • Session 1: *Properties of Rocks and Minerals*, pg 15 – 21	• Practice with hand lens and measurement of length and width; preparation for activity required	

P u b l i s h e d R e s o u r c e s

My notes

HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL * Resources are organized by topic	
RESOURCE	**NOTES**	**RESOURCES**	**NOTES**
Other Resources ▪ WB 90-91 ▪ WB 85		**Properties of Minerals and Rocks** FOSS: Earth Materials, ▪ Activity 2: *Scratch Test*, pp. 1-9	
▪ E10-11	▪ The uses and other properties column is engaging, but is not the focus of the standards.	▪ Activity 3: *Calcite Quest*, part 1, pp. 6-7	▪ Practice prediction, observation, and interpretation
▪ E9	▪ Performance Assessment	GEMS: Stories in Stone, ▪ Session 8: *Classifying Rocks and Minerals*, pp. 103-113	
▪ Lesson 2: *What are Rocks?* pp. E10-17	▪ *Identifying Rocks*, pp. E10-11 shows the basis from which classification of rocks developed, but is not a system of rocks used by geologists. ▪ *Cross-bedding*, p. E15, is beyond the standard. If used, *The Rock Cycle*, E16-17 might be best as a demonstration to conserve resources.	STC: Rocks and Minerals ▪ Lesson 3, *Learn More About Rocks*, pp. 31 – 36 ▪ Lesson 7, *Describing the Color of Minerals*, pp 63 – 67 ▪ Lesson 9, *Exploring the Luster of Minerals*, pp 75 – 80	▪ Rock classification by physical property ▪ Color and streak test ▪ A test of luster
▪ Investigative Challenge, p. E45 ▪ WB 94-95 ▪ WB 97		▪ Lesson 10, *Exploring the Hardness of Minerals*, pp. 83 – 88 ▪ Lesson 11, *Testing Minerals with a Magnet*, pp. 91-95 ▪ Lesson 12, *Describing the Shape of Minerals*, pp. 97 - 101	▪ A Hardness Test ▪ A connection to Grade 4 physical science on magnetism ▪ A cleavage test

HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL * Resources are organized by topic	
RESOURCE	**NOTES**	**RESOURCES**	**NOTES**
• Lesson 3: *What is the Rock Cycle?* pp. E48-53 • WB 100 • WB 102		Janice Van Cleave's *200 Icy, Freezing, Frosty, Cool & Wild Experiments* • *Scratch*, p. 84 • *Powdered*, p. 85 • *Smooth*, p. 85 **Rock Cycle** GEMS: *Stories in Stone*, • *Session 6: Formation of Metamorphic Rocks*, pp. 75 – 80	• A hardness test • A streak test • A cleavage test

If using the *Harcourt Science* program, the lessons listed below provide the needed support for student access to the identified content standards for this unit. These resources are provided within this *Guide*.

MY NOTES	RESOURCES IN THIS GUIDE	NOTES
	• Mineral Identification Lab, pg. 134	• *Hands-on exploration of* the properties of minerals: hardness, cleavage, fracture, streak, luster, an introduction to magnetism, estimating and measuring volume.
	• Rock Identification Lab, pg. 149	• *Guided inquiry* to examine the characteristics of igneous, metamorphic and sedimentary rocks.

Standards Alignment

Source	Description	Pages	ES 4a	ES 4b	PS 1e	6a	6b	6c	6d	6e	6f	Notes
FOSS: Earth Materials	*Activity 1: Mock Rocks*	1-8				▼	▼					Focus on measurement of length and width; requires teacher preparation (making of mock rocks 1 week prior to activity); teacher video is helpful on how to set up materials. Provides practice with hand lens
	Activity 2: Scratch Test	1-8	▼							▼	▼	An inquiry-based activity in which students determine the hardness of minerals. When implementing, be sure to use Mohs Hardness Scale.
	Activity 3: Calcite Quest, part 1	6-7	▼	▼		▼		▼				An inquiry-based activity in which students predict which rocks have calcite based on observation of a chemical reaction with vinegar. Lesson is focused on observation and interpretation.
	Activity 4: Take it for Granite, Part 1	6-7		▼								An inquiry-based activity on mineral identification
GEMS: Stories in Stone	Session 1: *Properties of Rocks and Minerals*	13 – 21	▼									Guided discovery to practice identifying properties of rocks and minerals
	Session 5: *Formation of Metamorphic Rocks*	73 – 88	▼									Modeling how metamorphic rocks are formed
	Session 8: *Classifying Rocks and Minerals*	103-113		▼								A guided discovery activity that can be used as an assessment of skills
Harcourt, Chapter 2, Lesson 1	Mineral Properties	E34 – 35		▼		▼				▼	▼	An activity in which students determine the hardness of minerals. Use a push pin or blunt knife instead of a nail and read *Science Background* on pg. E34.
	Investigate Log	WB38-39									▼	Use with *Mineral Properties Activity* on pg. E34-35.
	Minerals	E36 – 37		▼								Text. Emphasize definitions of minerals – that they are inorganic and naturally occurring. Images of minerals 4,8, and 6 on Mohs scale are in the wrong order.

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Source	Description	Pages	ES 4a	ES 4b	PS 1e	6a	6b	6c	6d	6e	6f	Notes
			Standards Supported in this Unit									
	Investigation Challenge Classifying Minerals	B37		▼								Identification of an unknown mineral. Minerals listed are too close to each other in hardness. Suggest using quartz instead of Calcite.
	Mineral Info	B 39		▼						▼		A performance assessment tool.
	Lesson Concept Review What Are Minerals?	WB30		▼								
	How to Use a Table of Diagnostic Properties	R 10-11		▼						▼		Reference Chart
Harcourt, Chapter 2, Lesson 2	Identifying Rocks	B 40-41									▼	A discovery activity in which students create their own classification of rocks. Teacher background provided is beyond the standard.
	Investigate Log	WB31-32									▼	To be used with Identifying Rocks, pages B40-41.
	Types of Rocks	B 42-47	▼									True. Earth's crust is made mostly of rocks; rocks are not crystals but can be made of crystals; cross-bedding is beyond the standards; Obsidian will not – be careful. Page B44 also aligned with 4b.
	Investigation Challenge Igneous Rock Textures	B 48	▼			▼						Students classify igneous rocks based on their tactile observations. Guided discovery with Venn Diagrams will work well to help students compare properties.
	Lesson Concept Review What are Rocks?	WB37	▼									Support in distinction between igneous, sedimentary and metamorphic rock definitions.
Harcourt, Chapter 2, Lesson 3	How Rocks Change	B 50-55	▼									True.
	Process Skills Practice Make a Model	WB38	▼									Students simulate the effect of running water on pebbles, stones, sand and mud.

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Source	Description	Pages	Standards Supported in this Unit: ES 4a	ES 4b	PS 1e	6a	6b	6c	6d	6e	6f	Notes
Lesson 3	Vocabulary Review: Recognizing Vocabulary	[illegible]	▼	▼								Vocabulary practice on types of rocks
Additional Lesson in this Guide to support the Harcourt Program	Mineral Identification Lab	Guide, page 134		▼	▼	▼	▼			▼		A series of activities in which students discover how to identify various minerals based on their physical characteristics and a chart of diagnostic properties.
	Rock Identification Lab	Guide, page 149	▼			▼	▼					A hands-on activity in which students use rocks as models for rock identification.
J. Van Cleave, 203 Icy, Freezing, Frosty, Cool and Wild Experiments	[illegible]	[illegible]		▼								Directions to lead students through a cleavage test
	[illegible]	[illegible]		▼								Directions to lead students through a streak test
	[illegible]	[illegible]		▼								Directions to lead students through a hardness test
STC: Rocks and Minerals	Lesson 10: *Exploring the Hardness of Minerals*	[illegible]		▼				▼				A discovery activity on the hardness of minerals.
	Lesson 11: *Testing Minerals with a Magnet*	[illegible]			▼							A research activity on magnetism in minerals.
	Lesson 12: *Describing the Shape of Minerals*	[illegible]		▼		▼						A concept map activity on the shape of minerals.
	Lesson 1: *Generalizations About Rocks*	[illegible]	▼			▼						Rock Classification by physical properties
	Lesson 7: *Describing the Color of Minerals*	[illegible]		▼		▼						Color and streak test
	Lesson 8: *Exploring the Luster of Minerals*	[illegible]		▼				▼				An activity on luster.

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Additional Lessons

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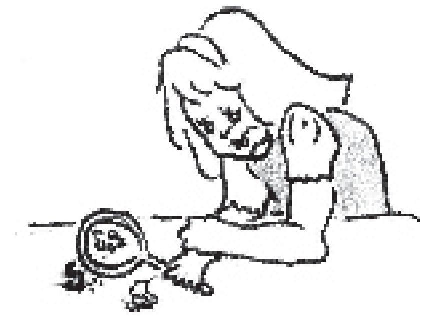
Mineral Identification Lab



Science Standards

4b. 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.

6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6b. Measure and estimate the weight, length, or volume of objects.

6e. Construct and interpret graphs from measurements.

Math Standards

Measurement and Geometry

Standard Set 3.0: Students demonstrate an understanding of plane and solid geometric objects and use this knowledge to show relationships and solve problems:

3.1 Identify lines that are parallel and perpendicular.

3.6 Visualize, describe, and make models of geometric solids (e.g., prisms, pyramids) in terms of the number and shape of faces, edges, and vertices; interpret two-dimensional representations of three-dimensional objects; and draw patterns (of faces) for a solid that, when cut and folded, will make a model of the solid.

Focus Concepts

- Common ores and minerals can be identified by properties of hardness, cleavage, color, and streak.
- Some properties (hardness, cleavage, color, and streak) are used within a table of diagnostic properties (Mohs Hardness Scale) to identify common ores and minerals.
- Students can differentiate between observation and inference.
- Explanations come from observations and the interpretation of observations.
- Students know how to measure and estimate the volume of objects.
- Students can interpret graphs.

Purpose

To provide students with an opportunity to identify common rock-forming and or minerals using charts of diagnostic properties.

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Background

The Grade 4 *Harcourt Science* text activity *Mineral Properties,* on pages B34-35, provides students with an introduction to mineral identification, focusing on the properties of hardness, color, and streak. This Mineral Identification Lab expands on these types of classification and introduces students to other properties of minerals that can be used for identification including cleavage, fracture, and luster. By exploring all 6 of these properties for mineral identification, students will be proficient in the use of the reference sheet provided on the Grade 5 California Standards Test (CST).

This series of lab activities are broken into manageable timeframes for instruction. Teachers can choose to do one or more sections a day depending on their schedules.

Why is identifying minerals important?

Because specific minerals are formed in specific ways, important clues to a location's geologic history can be discovered by knowing what minerals exist at that location. In addition, many minerals are used in specific ways, and some minerals are very valuable because of their usefulness. Knowing the identity of minerals found in particular locations is important to identify resources. Finally, students' work in the classification of minerals provides experience in detailed scientific observation and description; these skills are very important as students progress in science.

What is the difference between an ore and a rock-forming mineral?

By definition, a rock is one or more minerals. When there is a high enough concentration of a single mineral in a rock to make mining commercially viable, the rock is known as *ore*. When the concentration of a single mineral is not commercially viable, it is known as *rock-forming*.

Procedures

Equipment (per team of 2 students):

1 10x hand lens

1 Hardness Kit (samples of minerals with hardness 1-9, magnet and streak plate*)

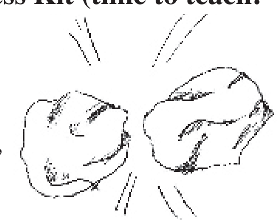
1 set of additional mineral samples (galena, halite, mica [biotite or muscovite], hematite & pyrite) *

1 copy of the Grade 5 CST Reference Sheet (attached)

* available for check-out through the district Math/Science/Technology center

Part 1

How to use the Hardness Kit (time to teach: 30 minutes)



1. Give each pair of students the minerals from a Hardness Kit.
2. Ask students to predict the minerals' hardness from least hard to most hard and record their predictions.
3. Using the minerals in the Kit, students take out the feldspar and the calcite.
   a. Students use the feldspar to scratch the calcite. Rub hard. Wipe the calcite with their finger.
   b. Did the calcite get scratched? (yes)
   c. Students use the calcite to scratch the feldspar. Rub hard. Wipe the feldspar with their finger.
   d. Did the calcite scratch the feldspar? (no)
4. Students follow the same process using other pairs:

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a. quartz and gypsum

b. apatite and talc

c. gypsum and talc

d. quartz and feldspar

5. Ask students to place the minerals in order of their hardness based on the results of their scratch tests (from least to most hard), and record their observations. Students may need to do additional scratch tests to confirm their order (apatite and gypsum).
6. Hand out Mohs Hardness Scale. Ask students to compare their results to it and discuss the differences between their order of hardness and the scale provided.
7. Students conclude the meaning of the numbers on Mohs Hardness Scale. (The higher numbered minerals are harder and will scratch the lower numbered minerals.)

Discussion Starters

- Are all minerals alike?
- What is one way we can tell minerals apart?
- What materials do you need to measure the hardness of a mineral?

Part 2

Find the hardness of an unknown mineral (time to teach: 30 minutes)

1. Give students a Hardness Kit and a sample halite crystal.
2. Students scratch the halite on the talc. (It will scratch. Halite is harder than talc.)
3. Students scratch the halite on gypsum. (It will scratch. Halite is harder than gypsum.)

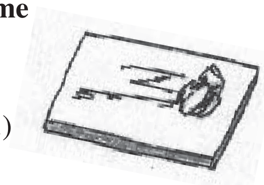
4. Students scratch the halite on calcite. (It will not scratch. Halite is a hardness between 2 and 3.)
5. Give students a sample of galena and ask the students to determine its hardness (between 2 and 3).

Discussion Starters

- If you were given two minerals, how would you determine which is harder?
- Why do geologists determine the hardness of minerals?
- When determining the hardness of a mineral, how is the Mohs Scale used?

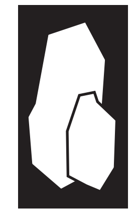
Part 3

Exploring *streak* and *luster* (time to teach: 20 minutes)



Note: To clean the streak plate, rub a little abrasive cleanser (Comet, Ajax, etc.) water on the plate, then rinse.

1. Define luster as the way a mineral shines (reflects light).
2. Ask students to separate metallic from non-metallic minerals (galena, pyrite and hematite are metallic)
3. Define *streak* as the color left when a mineral is scratched on a ceramic plate.
4. Streak the galena. Rub hard. What is the color of the streak? (black)
5. Streak hematite and pyrite. Rub hard. What is the color of their streaks? (hematite = reddish-brown; pyrite = greenish-black)
6. Note that all the metallic minerals have a colored streak.
7. Streak halite, quartz, calcite, and mica. What is the color of



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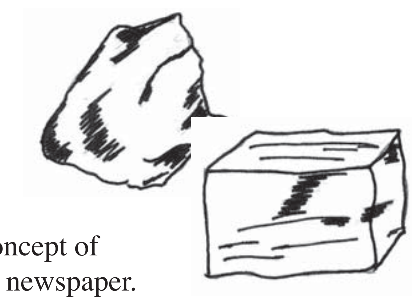
their streak? (They do not produce a colored streak. Only metallic luster minerals give colored streaks.)

8. Students can conclude that one difference between metallic luster minerals and non-metallic minerals is their ability to streak.

Discussion Starters

- How do we use the properties streak and luster to identify a mineral sample?
- Do all minerals have streak and luster?
- What classifies a mineral as metallic? How can you test a sample to verify your prediction?

Part 4 **Exploring *cleavage* and *fracture* (time to teach: 20 minutes)**



1. Explain that *cleavage* occurs when a mineral breaks into geometric planes (flat surfaces).
2. You can give students an introduction to the concept of cleavage with a sheet of newspaper. Tear the piece of newspaper relatively straight down the middle. Explain that minerals break by its cleavage just as the newspaper did. The *cleavage plane* is where bonds between materials are weak. In the newspaper, fibers are generally lined up from the paper's top to its bottom. You can tear the paper straight if aligned with the fibers of the paper. In the same way, breaking a mineral along a cleavage plane breaks the mineral along smooth edges.
3. Students observe which of their mineral samples broke into planes and which did not. (Calcite, halite, pyrite, galena and mica broke into planes; quartz and hematite did not break into flat planes. They have fractures.)
4. Ask students how many planes do each of their minerals have?
   a. Halite, pyrite, and galena have parallel and perpendicular pairs of flat sides (cubic)
   b. Calcite has parallel pairs of flat sides (parallelogram)
   c. Mica has 1 flat side (flat)

Discussion Starters

- Which minerals have cleavage and which have fracture?
- Why are cleavage and fracture used to help identify a mineral sample?
- How do the principles of cleavage and fracture relate to the cutting of precious minerals like diamonds?

Part 5 **Other properties and connections (time to teach: 25 minutes)**

1. *Magnetism*: Use the magnet in your Hardness Kit to determine if any of the minerals you have are magnetic (magnetite). If you have taught the magnetism section of the physical science unit, students will recognize this property. If students have not yet studied magnetism, discuss how some minerals are attracted to each other and others are not. This is a special property that will be explored later in depth.
2. *Volume of an irregular shaped object*: Students can begin to explore the concept of volume using minerals. Students will learn the formula for the volume of regular shaped objects in Grade 5 mathematics.

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a. Provide students with a graduated cylinder, measuring cup, or a clear cup with vertical sides that can be calibrated (units of volume measurement).

b. Fill the cylinder with a set amount of water (e.g. 25 ml).

c. Submerge a mineral in the cylinder and record the new water level.

d. Subtract 25 ml from the new water level for the volume of the mineral.

3. Once students have found the volume of 2-3 minerals, have students begin estimating the volume of minerals before submerging them in water. You may choose to ask students questions such as:

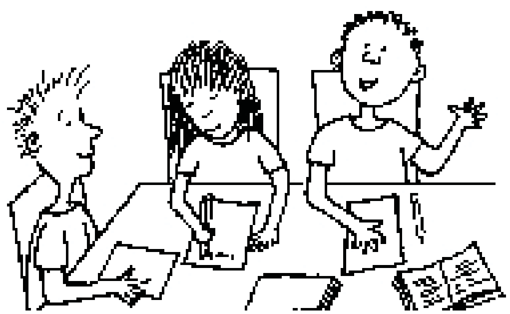
   a. How close is your prediction to the actual volume of the mineral?

   b. How can you increase the accuracy of your predictions?

   c. Why do we use water to determine the volume of irregular shaped objects?

Discussion Starters

- Why does submerging a mineral in water tell us its volume?
- Why do some rocks seem attracted to each other and others are not?



Sample Performance Assessment **(time to teach: 25 minutes)**

1. Give each student a copy of the CST Reference Sheet, a streak plate, and a magnet.
2. Give the students a mineral sample that they have not worked with before.
3. Using the resources provided, have the student identify the unknown mineral. Students should use at least two (2) tests to confirm the mineral's identification and explain how these tests led to the students' conclusion.

Sources Used in Developing This Lesson

Full Option Science System: Earth Materials, *Take it for Granite: part 1, Calcite Quest*: *part 1*

Science/ Technology for Children: *Rocks and Minerals*, National Science Resource Center, Lessons 7 – 15, pages 63 – 124.

Van Cleave, J. *Scratch, Powered, and Smooth,* from 203 Icy, Freezing, Frosty, Cool and Wild Experiments, pg. 84-85.

Additional Lessons

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Reference Sheet for Mineral Identification Lab

Mineral Identification Table

Mineral	Hardness	Luster	Streak	Color	Other
Calcite	3	nonmetallic	white	colorless, white	bubbles when acid is placed on it
Feldspar	6	nonmetallic	none	colorless, beige, pink	
Galena	2.5 – 3	metallic	gray	lead-gray	heavy for its size
Gold	2.5 – 3	metallic	golden yellow	yellow	used for jewelry
Graphite	1 – 2	metallic	black	gray to black	feels greasy
Hematite	5 – 6.5	metallic or nonmetallic	reddish brown	silver-gray or red	
Hornblende	5 – 6	nonmetallic	none	dark green to black	
Magnetite	6	metallic	black	black	magnetic
Mica	2 – 2.5	nonmetallic	none	dark brown, black or silver-white	flakes when peeled
Pyrite	6 – 6.5	metallic	greenish black	brassy yellow	called "fool's gold"
Quartz	7	nonmetallic	none	colorless, white, rose, smoky, purple, brown	
Talc	1	nonmetallic	white	white, greenish to gray	feels greasy

Mohs Hardness Scale

Mineral	Hardness
Talc	1
Gypsum	2
2.5 Fingernail	
Calcite	3
3.0 Copper Penny	
Fluorite	4
Apatite	5
5.5 Glass	
Feldspar	6
6.5 Steel File	
Quartz	7
Topaz	8
Corundum	9
Diamond	10

Name: ____________

Mineral Identification Lab

Part 1 How to use a Hardness Kit

You will need:

- A sample of each of the following minerals: feldspar, calcite, quartz, gypsum, apatite, and talc.
- A copy of Mohs Hardness Scale (your teacher will give this to you part-way through the lesson).

Background:

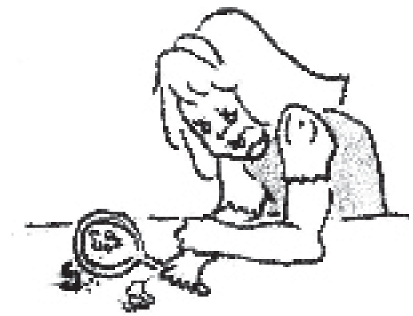
Geologists identify common rock-forming and ore minerals based on their physical and chemical properties. In this activity you will practice determining the hardness of minerals and determine why scientists use Mohs Hardness Scale to assist them in their work.

Procedures:

1. Look at the set of minerals in front of you. By examining the minerals closely, predict the order of mineral hardness (least hard to most hard).

____________ (Least hard) ____________ ____________

____________ ____________ ____________ (Most hard)



2. Use the feldspar to scratch the calcite. Rub hard. Wipe the calcite with your finger to remove any loose sediment. Did the feldspar get scratched?

____

3. Use the calcite to scratch the feldspar. Rub hard. Wipe the feldspar with your finger to remove any loose sediment. Did the feldspar get scratched?

____

4. Which is harder, calcite or feldspar? How do you know?

____

____

5. Follow the same process as above with quartz and gypsum, apatite and talc, gypsum and talc, quartz and feldspar. Record your observations below:

Mineral (a)	Mineral (b)	a scratched b	b scratched a	Which is harder?
Quartz	Gypsum			
Apatite	Talc			
Gypsum	Talc			
Quartz	Feldspar			

6. Based on the results of your scratch tests, place your minerals in the order of their hardness.

_______________ (Least hard) _______________ _______________

_______________ _______________ _______________ (Most hard)

7. Compare your results with your predictions.

____

8. Ask your teacher for a copy of Mohs Hardness Scale. Compare your results with the order of hardness on the scale.

9. How is Mohs Hardness Scale organized?

____

10. Why do you think scientists use this tool?

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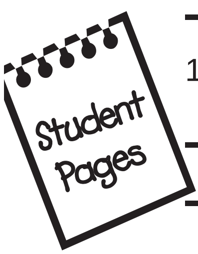


Name:

Part 2 Find the hardness of an unknown mineral

You will need:

- A Hardness Kit
- Sample halite crystal and galena

Procedures:

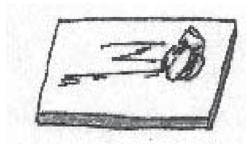
1. Scratch the halite on the talc. Which is harder? _______________
2. Scratch the halite on gypsum. Which is harder? _______________
3. Scratch the halite on calcite? Which is harder? _______________
4. Based on the results of using the Hardness Kit, what is the hardness of halite? _______________
5. Get a sample of galena from your teacher. Using the same process you used with halite, what is the hardness of galena? _______________
6. Based on these two samples, how do you use the Hardness Kit to determine the hardness of an unknown mineral?

____

____

Name:

Part 3 **Exploring *streak* and *luster***



You will need:

- A streak plate
- Minerals: calcite, galena, halite, hematite, mica, quartz, pyrite

Background:

In part 1, you explored the physical property of *hardness*. In this activity you will explore two additional physical properties, *streak* and *luster.*

Streak is defined as the color left when a mineral is scratched on a ceramic plate.

Luster is defined as the way a mineral shines or reflects light.

Procedures:

1. Look at the mineral samples in front of you. Separate them into two groups, metallic luster and non-metallic luster. Record your classifications below.

Metallic	**Non-metallic**

2. Share your classification.

Record any changes to your classification.

Metallic	**Non-metallic**

3. Discuss your classification with the help of your teacher. Did you agree with the additional information your teacher provided? How did this change your understanding of *luster*?

4. Streak each of the following minerals and record the color of their streak.

Mineral	Color of Streak
Galena	
Hematite	
Pyrite	
Halite	
Quartz	
Calcite	
Mica	

5. What patterns do you notice about the minerals that produce a streak and those that do not?

Student Pages

Name:

Part 4 Exploring *cleavage* and *fracture*

You will need:

- Samples of the following minerals: calcite, galena, halite, hematite, pyrite, mica, and quartz

Background:

Cleavage occurs when a mineral breaks into geometric planes (flat surfaces).

Fracture is when a mineral does not break into geometric planes, but curved planes.

Procedures:

1. Examine the selection of minerals. When the mineral samples were broken into small pieces for your use, which were broken into cleavage and which were broken into fractures?

Cleavage	Fracture

2. How many planes of cleavage does each of your minerals have?

Mineral	Cleavage			Fracture
	Cubic	Parallelogram	Flat	
Calcite				
Galena				
Halite				
Hematite				
Mica				
Pyrite				
Quartz				

3. How does identifying cleavage and fracture assist you in identifying minerals?

Student Pages

Name:

Part 5 Other properties and connections

You will need:

- A Hardness Kit
- A magnet
- A graduated cylinder, measuring cup, or clear cup with vertical sides that can be calibrated with units of volume measurement
- Water

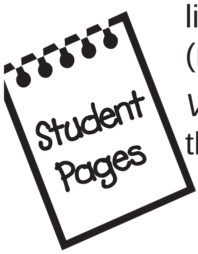
Background:

Magnetism is a physical property in which objects composed of iron are attracted to magnets.

Calibrating a cup: By using a known quantity of water (10 ml) markings can be made in any container to show the graduated amounts of liquid a container will hold. By making markings in regular increments with a permanent marker, the cup can be used many times to show the amount of liquid in the container.

To read the correct water level on the container, note that water's surface tension causes it to curve slightly toward the sides of any container. When you look at the container at eye level, it may look as though there are two lines of liquid at the surface. The bottom line is the accurate reading of the water level (meniscus).

Volume is defined as the amount of space a three-dimensional object takes up.



Procedures:

Magnetism:

1. Using the magnet and the Hardness Kit, determine which mineral(s) are attracted to the magnet.

Volume of an irregular shaped object:

2. Use your graduated cylinder, measuring cup or clear cup calibrated with units of volume measurement.
3. Fill the container with a set amount of water (e.g. 25 ml).
4. Choose a mineral sample to submerge in the cylinder completely and record the new water level on the table provided.
5. Subtract the amount of water you started with (25ml) from the new water level. The difference is the volume of the mineral sample. Record your data on the table provided. Repeat this with 2-3 mineral samples.

Mineral	Original Water Level	New Water Level	Volume of Mineral Sample
Example	25 ml	40ml	15ml

Name:

6. Now that you know how to determine volume, estimate the volume of the remaining mineral samples in your Hardness Kit, then follow the same procedure to determine the actual volume.

Mineral	Predicted Volume	Original Water Level	New Water Level	Volume of Sample

7. How close are your predictions to the actual volume of the mineral samples?

8. How could you increase the accuracy of your predictions?

9. Why do you think water is used to determine the volume of irregular shaped objects?

Name:

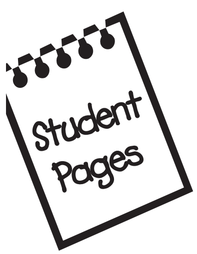
Performance Assessment

You will need:

- Reference Sheet
- A streak plate
- A magnet
- An unknown mineral

Directions:

Using the materials provided, identify the unknown mineral you have been given. Explain each step you perform and how these steps help you to make your conclusion. You may use illustrations or graphics to support your explanation.



Mineral Identification Lab

Answers to Student Pages

Part 1 How to use a Hardness Kit

1. Student answers will vary as these are the students' predictions.
2. Yes
3. No
4. Feldspar is harder than calcite. We know this because feldspar will scratch calcite but calcite will not scratch feldspar.

Mineral (a)	Mineral (b)	a scratched b	b scratched a	Which is harder?
Quartz	Gypsum	*yes*	*no*	*quartz*
Apatite	Talc	*yes*	*no*	*apatite*
Gypsum	Talc	*yes*	*no*	*gypsum*
Quartz	Feldspar	*yes*	*no*	*quartz*

6. talc, gypsum, calcite, apatite, feldspar, quartz
7. Student answers will vary.
8. Student answers will vary.
9. Mohs Hardness Scale is organized by a mineral's relative hardness - from least to most hard (talc and gypsum can be scrateched by your fingernail) on a scale of 1 - 10.
10. Scientists use this scale to identify the relative hardness of minerals as one test for mineral identification.

Part 2 Find the Hardness of an unknown mineral

1. Halite
2. Halite
3. Calcite
4. Halite has a hardness between 2 and 3 on Moh's Hardness Scale.
5. Galena has a hardness between 2 and 3.
6. To determine the hardness of an unknown mineral, begin with the softest mineral (talc) and test if the unknown sample will scratch it. If it does, continue with the next hardest mineral until finding the mineral that cannot be scratched. This will provide the relative hardness of the unknown mineral.

Part 3 Exploring *Streak* and *Luster*

1. Student answers will vary. Correct classifications are: Metallic - galena, pyrite, hematite; Non-metallic - calcite, halite, mica, quartz
2. Student answers will vary
3. Student answers will vary

Mineral	Color of Streak
Galena	*black*
Hematite	*reddish - brown*
Pyrite	*greenish - black*
Halite	*no streak*
Quartz	*no streak*
Calcite	*no streak*
Mica	*no streak*

5. Metallic luster minerals give a colored streak. Non-metallic do not.

Part 4 **Exploring *Cleavage* and *Fracture***

Cleavage	**Fracture**
Calcite, halite, pyrite, galena, mica	*quartz, hematite*

Mineral	**Cleavage**			**Fracture**
	Cubic	**Parallelogram**	**Flat**	
Calcite		*yes*		
Galena	*yes*			
Halite	*yes*			
Hematite				*yes*
Mica			*yes*	
Pyrite	*yes*			
Quartz				*yes*

3. How a mineral breaks is another indicator of its physical properties. The more properties confirmed for a mineral, the better chance for a positive identification.

Part 5 **Other properties and connections**

Answers will vary for questions 1 - 8.

9. Objects with irregular shapes, like mineral samples, cannot be easily measured (students will learn the algorithm for volume of regular shaped objects in Grade 5), but water fills whatever container it is in. The sample displaces a specific amount of water, and this amount is equal to the sample's volume.

Performance Assessment

The students' response should include the following:

Note: the mineral given to the student should be listed on the reference sheet.

- At least two (2) tests of mineral identification. These tests should be selected from: hardness, streak, luster, cleavage, and fracture.
- The student may note that color is rarely used for identification because many minerals have a variety of colors; therefore, this is unreliable as an identifier.
- For each test, the steps of the test should be explained.
- The student should explain how the results of each test move the student closer to identifying the mineral, using the "Mineral Identification Table" and Mohs Hardness Scale as resources.

Additional Lessons

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Rock Identification Lab

Science Standards

4a. Students know how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).

6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6b. Measure and estimate the weight, length, or volume of objects.

Focus Concepts

- Observable properties are used to identify and distinguish between igneous, sedimentary, and metamorphic rocks.
- Students can differentiate between observation and inference.
- Explanations come from observations and the interpretation of observations.
- Students know what weight and length represent.
- Students know how to measure and estimate the weight and length of objects.

Purpose

The purpose of this lab is for students to examine models that represent different types of rock compositions to practice identifying the three main types of rocks.

Background

Rocks vs. Minerals: Minerals have a very specific definition. They must be naturally occurring (ice on the pond is a mineral, ice in your refrigerator is not). It must have never been alive, in other words it is *abiotic* or *inorganic* (pearls and coal come from organic sources so they are not minerals). It must be a cryatalline solid, and it must have a consistent chemistry. Rocks, on the other hand, do not have such a formal definition.

Rocks are "made of more than one mineral." Almost anything hard is a rock if it does not meet the criteria for a mineral. In the *Harcourt Science* activity *Identifying Rocks*, students are asked to observe and describe different kinds of rocks (support for *Investigation and Experimentation 6a)*. These observations can be the basis for a classification system of rocks, but the activity does not actively support the current classification system used by geologists.

In this activity, students will learn about the rock classification system and how to apply the system to unknown "rocks." The lesson focuses on students' use of rock classification by practicing their observation and measurement skills. Classifying rocks as *igneous, metamorphic* and *sedimentary* is challenging,

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as many rocks have variations that make identification difficult, even for geologists. For this reason, this lab will use candy bars to represent model rocks.

Safety Note: Tthis activity should not be implemented in a classroom where students are allergic to peanuts.

Procedures

You will need:

Igneous rocks such as: basalt, granite, obsidian, pumice *
Sedimentary rocks such as: sandstone, shale, limestone, conglomerate *
Metamorphic rocks such as: marble, quartzite, gneiss, schist *
Selection of candy bars (Kit-Kat, Butterfinger, Hershey's milk chocolate, Snickers, other) Bite-sized bars (unwrapped) or pieces of larger bars are preferred.
Ruler
Balance
Paper towels
Hand lens

* These materials can be checked-out from a district Math/ Science/Technology center.

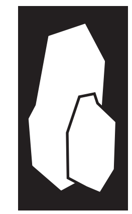
Introduction

1. Begin this lesson with a short discussion on why identification of rocks is important:

- We live on the outer surface of the Earth. What is the Earth's surface made of?
- What is the difference between rocks and minerals?
- What are the major types of rocks called? How were they formed?

This might be accompanied by student reading of *Harcourt Science*, pages B42 – B47 (omitting the discussion of cross-bedding). These questions will lead into the following discussion in which you reinforce the definitions of the three major types of rocks and show examples of each:

2. Introduce igneous rocks with the definition "igneous rocks cool from a melt." Use basalt and granite as main examples, but show obsidian and pumice as variations on this theme.
   a. Discuss the origins of igneous rocks. When looking at a sample rock, some have small crystals and some have larger crystals. Explain that the size of the crystal relates to the speed at which the rock cooled. If the rock cooled quickly, only small crystals had time to form. When rocks had a much longer time to cool (below the surface), larger crystals had time to develop. (Notice the large crystals in granite.)
3. Sedimentary rocks are made of pieces of various things, or are precipitated from seawater.
   a. Discuss how various characteristics (rounding, size, etc.) relate to the name of the rock.
4. There are two types of metamorphic rocks, *foliated* and *non-foliated*. Although students do not need to know this distinction, the discussion may help students identify metamorphic rocks. Non-foliated includes marble and quartzite. Examples of foliated include gneiss and schist. The foliated have been squeezed and have directional lines (notice that gneiss has stripes).



Additional Lessons

This sample nstructional vity illustrates sible strategies accessing the tent within the standards.

5. Students will use common candy bars to model the types of rock.

6. Have students use the sheet provided to draw each “rock sample,” collect measurements on each sample, and explain what type of rock each candy bar represents, providing evidence to support each conclusion. You might want to do the first one together as a sample.

7. Once students have completed the lab, review their results. Using the student sheets, students share their results using their evidence to build consensus in the classroom. Note the descriptive vocabulary they use and how these terms help other students understand the comparisons being made.

Discussion Starters

- What are the characteristics of igneous, sedimentary, and metamorphic rock?
- Why is it sometimes easier to identify candy as types of rock than it is to identify actual rock samples?
- Give the reasons why you would expect to find different types of rock in your backyard than on the Hawaiian Islands.

Notes to the Teacher

Conclusions in this activity will reflect the candy bars you use. The following are some suggestions for selecting candy for this activity:

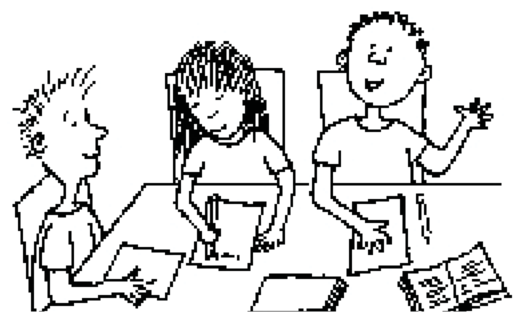
- Snickers represents a conglomerate sedimentary rock.
- Kit-Kat represents a layered sedimentary rock.
- Hersheys Milk Chocolate represents a fine-grained sedimentary rock like shale.
- Crunch Bar represents a large crystal igneous rock like granite.
- Butterfinger represents a metamorphic rock like schist.

Sources Used in Developing This Lesson

Harcourt Science, Grade 4, pages B42 – 47

LHS GEMS: *Stories in Stone*, 1995, Regents of the University of California, session 8, pages 103-112.

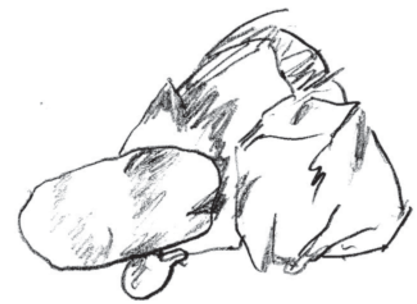
STC: *Rocks and Minerals*, 1997, National Science Resource Center, Lesson 3 *Learning More about Rocks*, pages 31-36.



Name:

Rock Identification Lab

For each candy bar provided by your teacher, collect evidence to lead you to a conclusion on what type of rock (igneous, sedimentary, or metamorphic) each candy bar represents.



Procedures:

1. Write the name of the type of candy in the space provided (Kit-Kat, Butterfinger, etc.)
2. **Draw** your sample using crayons or colored pencils.
3. **Identify** the colors in your sample.
4. **Describe** the texture of your sample.
5. **Estimate** the length of your sample.
6. M**easure** your sample using a ruler. Note the direction for your measurement on your drawing.
7. **Estimate** the weight of your sample, then **weigh** it. To keep the candy clean, put a paper towel under the candy on your balance. (Be sure to subtract the weight of the paper towel from your total samples' weight.)
8. **Name** your "rock" as igneous, sedimentary, or metamorphic.

Name of Candy	Draw your sample	Color(s)	Texture	Length: Estimate / Actual		Weight: Estimate / Actual		Type of "Rock"

Student Pages

Name:

Rock Identification Lab

Name of Candy	Draw your sample	Color(s)	Texture	Length: Estimate / Actual		Weight: Estimate / Actual		Type of “Rock”

1. What type of evidence was most helpful in determining which candy bar represented each type of rock?

____

____

2. What additional information would you like to have in order to confirm your identification?

____

____

Student Pages

Water Erosion Unit

My notes

The *Water Erosion* unit is focused on the role of water in changing Earth's surface. Water erosion can be rapid or slow, depending on the circumstances. As snow melts, streams move sediment and minerals down mountains and eventually to the ocean. During this process, mountains wear into smaller and smaller pieces of sediment, imperceptible in the here and now, but cumulatively dramatic over many years.

As a coastal city, our students may be aware of the dramatic effect of the ocean on the coast during a storm, but they may not be familiar with the role of streams and rivers in changing Earth's landscape. When students are in Grade 6, they will learn that the size of Earth does not change as a result of the geologic cycle of which this study is a part.

Across Los Angeles there are many ways to help students understand the role of water in erosion. The city's museums have quality exhibits on the power of moving water to change the landscape. For a list of district-approved field trips and assemblies, review LAUSD publication GC-148, pg. 35-67. This publication also includes necessary LAUSD bulletins on transportation, safety, and other issues related to field trip excursions.

California Academic Content Standards – This unit focuses on content standards 5b – 5c, with significant support for building science process skills in I&E standards 6a, 6c, 6d, and 6f.

California Academic Content Standards:

5b. Students know natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.

5c. 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).

6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

6f. Follow a set of written instructions for a scientific investigation.

Vocabulary – The core vocabulary for the *Water Erosion* unit focuses on ways to describe the cause and movement of Earth's materials due to water. Students become familiar with the terms used to describe different sized sediment. Additional vocabulary reflects terminology students may have been introduced to in Grade 2 and terms that they will become familiar with as a result of water erosion activities. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons – The additional lesson for this unit is *Sandy Beach*.

Critical Questions

- What are the different roles of water in changing Earth's surface?
- What are some natural processes that result in the breakdown of boulders into sand, silt, and clay?

MY notes

Connections

The following are optional connections that can be made across the curriculum. Specific standards citations for these connections can be found in the publisher's materials chosen for instruction.

Language Arts: Students learn a number of vocabulary terms in this unit. As a part of this study, students find that in science, terms were developed to describe phenomenon. Understanding common roots and affixes derived from Greek and Latin is helpful in understanding science vocabulary. Students will also practice reading different types of text, and respond to this text in oral settings.

History–Social Science: Students will practice identifying absolute locations using longitude and latitude.

Background

Teachers can make connections between this and the *Rocks and Minerals* unit by explaining the process by which boulders become smaller and smaller pieces of sediment. Students should recognize that the terms *boulder, cobble, pebble, sand, silt,* and *clay* are terms that describe the size of each grain or sediment. Students do not need to know the measured requirements for each size term, but they should be familiar with the order of the terms used to describe the size of sediment particles. Once students have examined rocks and minerals in a previous unit, they may enjoy exploring sand under a hand lens or microscope. Students can trace the minerals in sand to their point of origin, and anticipate where the sand would go next or where it came from.

"While you are experimenting, do not remain content with the surface of things. Don't become a mere recorder of facts, but try to penetrate the mystery of their origin."

- Ivan Pavlov

Grade 4 Vocabulary
Water Erosion

Core

natural process
rock
rock cycle
sedimentary rock
thawing
transport
weathering

freezing
geologist
igneous rock
landform
landslide-
(mass movement)
metamorphic rock
mineral

abrasion
creep
crystalline
deposition
dissolve
earthquake
erosion
faults

Additional

expand
grains
ice
interact
land surface
layers
oxygen (O)
parent rock

physical-
weathering
processes
property
rapid
sediment
soil
solidify
temperature

agent
alternate
alter
carbon dioxide (CO_2)
cemented
chemical weathering
combination
composition

Size Terms

boulder
cobble
pebble
sand
silt
clay

Investigation & Experimentation

Grade 4

cause-and-effect
conclusion
differentiate
evidence
inference
interpret
investigation
measure
multiple trials
observation
opinion
prediction
record
result

Grade 5

classify
conclude
controlled-
variable
criteri a
data
dependent-
variable
evidence
independent-
variable
infer
quantitative

Published Resources

California Academic Content Standards:

5b. Students know natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.
5c. 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).
6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
6c. Formulate and justify predictions based on cause-and-effect relationships.
6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
6f. Follow a set of written instructions for a scientific investigation.

My notes	HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL * Resources are organized by topic		My notes
	RESOURCE	**NOTES**	**RESOURCES**	**NOTES**	
	Chapter 1 • Lesson 1, *What Processes Change Landforms?* pg. B4-11 • WB 76-77 • Investigative Challenge, p. B10	• Focus on how water causes the land formations to change	**Freezing and Thawing** The Amazing Earth Model Book • *Glaciers,* pg.94-99	• A model of the role of glaciers in erosion.	
			Erosion by Moving Water The Amazing Earth Model Book • Erosion: A River's Run, pg. 89 – 93	• A model of how water changes the shape of a river.	
	Chapter 3 • Lesson 3, *What Are Some Ways to Conserve Soil?* pg. B74-81 • WB 100 • Investigative Challenge, p. B43	• Emphasize how soil is lost	GEMS: River Cutters • Session 2: *Creating and Charting Rivers*, pg. 17 – 21	• Creating a river	
			Project WET • Just Passing Through, pg. 166	• The path water takes and the resulting erosion	

Published Resources

MY NOTES	HARCOURT SCIENCE TEXTBOOK RESOURCE	HARCOURT SCIENCE TEXTBOOK NOTES	SUPPLEMENTAL * Resources are organized by topic RESOURCES	SUPPLEMENTAL NOTES	MY NOTES
			California Legacy 2000 • Watersheds and Erosion, Lesson 3, pg. 16-19	• How water moves land and the role of plants in minimizing erosion	
			STC: Land and Water • Lesson 3: *Modeling Rain on Land,* pg. 47 – 53	• A simulation of the effect of rain on soil (run-off)	
			• Lesson 4: *Investigating Streams,* pg. 55 – 66	• Practicing how to use a stream table including simple prediction and measurement.	
			• Lesson 5: Examining Earth Materials, pg. 69 - 78	• Properties of soil and how this influences erosion and deposition.	
			• Lesson 7: *Where does the Soil Go?*, pg 93 – 101 •	• Tracking the speed of run-off and the movement of soil	
			• Lesson 8: *Bird's Eye View*, pg. 103 – 114	• Creating graphic representations of streams made in stream table	
			• Lesson 10: *Rushing Rivers: Exploring Flow*, pg. 127 – 134	• Predict and model how a rushing river alters land.	
			• Lesson 11: *Hills and Rocks*, pg 137 – 144	• How natural land formations affect the direction and flow of water.	

If using the *Harcourt Science* program, the lessons listed below provide the needed support for student access to the identified content standards for this unit. These resources are provided within this *Guide*.

MY NOTES	RESOURCES IN THIS *GUIDE*	NOTES
	• Sandy Beach, p.163	• A series of guided inquiry explorations into the effects of water on rocks and minerals through the examination of beach sand.

Published Resources

My notes	HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL * Resources are organized by topic		My notes
	RESOURCE	NOTES	RESOURCES	NOTES	
			Waves, Wetlands, and Watersheds • The Layered Jar, pg. 30-31 • Sandy's Journey to the Sea, pg. 31-34 • No Ordinary Sandy Beach, pg. 35-39	• How gravel, sand and pebbles settle in water • A visualization of the path rock travels from the mountains to the beach	

Source	Description	Pages	Standards Supported in this Unit									Notes
			ES 4a	ES 5a	ES 5b	ES 5c	6a	6b	6c	6d	6f	
California Legacy 2000: Fountains of Columbia	Lesson 3: *Watersheds and Erosion*	16 – 19		▼		▼	▼		▼		▼	A two part activity in which students examine how water moves gravel, sand and soil (part 1) and the role of plants in minimizing land erosion (part 2).
GEMS: River Cutters, Session 2	Creating and Charting Rivers	17 – 21				▼	▼					Students simulate a river in a stream table. Students make observations and inferences on how rivers from geologic formations. Recommended that this activity follow session 1.
Harcourt, Chapter 1, Lesson 1	How Water Changes Earth's Surface	B 4 - 5		▼		▼	▼		▼			A simulation of how moving water can affect Earth's surface. Requires a streamtable.
	Investigate Log	WB 76 - 77		▼		▼	▼		▼			Accompanies activity, How Water Changes Earth's Surface on pg B4-5
	Changes to Earth's Surface	B 6					▼					Text.
	Changes to Earth's Surface	B 7 – 8			▼							Text
	Investigative Challenge: *More About Earth's Forces*	B 10		▼	▼	▼	▼		▼			A research activity in which students collect graphic images of weathering processes.
	Changes to Earth's Surface	B 6 – 11		▼		▼						Cooperative groups work well to jigsaw this text. Students may need larger images
Harcourt, Chapter 2, Lesson 3	Process Skills Practice: *Make a Model*	WB 100	▼			▼						Students simulate the effect of moving water on pebbles, course, sand and mud.
	Activities for Home or School: *Weathering Rock*	B57	▼	▼	▼	▼	▼		▼	▼		An activity to observe the effect of water on a "soft rock".

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Source	Description	Pages	Standards Supported in this Unit									Notes
			ES 4a	ES 5a	ES 5b	ES 5c	6a	6b	6c	6d	6f	
Harcourt, Chapter 3, Lesson 3	Soil Conservation	B 76 - 77		▼		▼						Text
	Soil Erosion	B 74 – 75				▼						An activity in which students model ways to plow a hill to minimize erosion.
Additional Lesson in this Guide to support the Harcourt Program	Sandy Beach	Guide, page 163	▼	▼	▼	▼	▼		▼	▼		A series of inquiry-based investigations into the properties of sand and how these properties tell a tale about the movement of rock in reshaping earth's surface.
Project WET	Just Passing Through	166		▼		▼						An active simulation of water's path down hill and the erosion that results.
STC: Land and Water, Lesson 3	Lesson 3: *Modeling Rain on Land*	47 – 53				▼	▼					Students create a simulation to investigate what happens to land after it rains
	Lesson 4: *Investigating Streams*	55 – 66				▼		▼				A hands-on activity in which students explore what happens when water flows from a single source point. A long session. Includes measurement of liquid in a graduated cylinder, length and width of stream
	Lesson 5: *Examining Earth Materials*	69 – 78			▼		▼					An activity in which students describe the characteristics of four different types of soil
	Lesson 7: *Where Does the Soil Go?*	93 – 101		▼		▼	▼		▼		▼	An activity on erosion of land due to water movement and erosion of sediment due to abrasion. Students make observations and inferences based on simulation
	Lesson 8: *Bird's – Eye View: Looking at the Parts of a Stream*	103 – 114								▼		Students are directed how to create bird's – eye view drawings of stream and label the formations

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Standards Alignment

Source	Description	Pages	Standards Supported in this Unit ES 4a	ES 5a	ES 5b	ES 5c	6a	6b	6c	6d	6f	Notes
	Lesson 10: *Rushing Rivers: Exploring Flow*	127 - 134		▼				▼	▼			A discovery activity in which students measure simulated rivers. Students make predictions on how land formations will change due to fast and slow moving water. Students compare land formations caused by fast and slow moving water.
	Lesson 11: *Hills and Rocks: How Nature Changes the Direction and Flow of Water*	137 – 146		▼					▼		▼	An inquiry activity in which students formulate predictions on how erosion of land slowly changes the direction and flow of water
The Amazing Earth Model Book	Erosion: A River's Run	89				▼						A simulation / model of how water changes the shape of a river.
	Glaciers	94 – 99			▼							A simulation / model of how glaciers erode rock.
Waves, Wetlands, and Watersheds	Activity 4.1a: *The Layered Jar*	30-31				▼			▼			An activity in which students can observe how rocks, gravel and sand separate into layers in water.
	Activity 4.1b: *Sandy's Journey to the Sea Reading Activity*	31-34		▼	▼	▼						An activity in which students visualize the path of a rock that travels from the top of a mountain to a beach.
	Activity 4.2: *No Ordinary Sandy Beach*	35-39			▼							Students observe sand to determine how "old" it is and where it may have come from.

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Additional Lessons

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standards.

Sandy Beach

Science Standards

4a. Students know how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).

5a. 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.

5b. Students know natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.

5c. 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).

6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6f. Follow a set of written instructions for a scientific investigation.

History-Social Science Standards

4.1 Students demonstrate an understanding of the physical and human geographic features that define places and regions in California.

1. Explain and use the coordinate grid system of latitude and longitude to determine the absolute locations of places in California and on Earth.

2. Distinguish between the North and South Poles; the equator and the prime meridian; the tropics; and the hemispheres, using coordinates to plot locations.

Language Arts Standards

1.4 Know common roots and affixes derived from Greek and Latin and use this knowledge to analyze the meaning of complex words (e.g., *international*).

Comprehension and Analysis of Grade-Level-Appropriate Text

2.2 Use appropriate strategies when reading for different purposes (e.g., full comprehension, location of information, personal enjoyment).

Comprehension

1.1 Ask thoughtful questions and respond to relevant questions with appropriate elaboration in oral settings.

Focus Concepts

- The process of rocks changing from one form to another is called the rock cycle.

Additional Lessons

This sample nstructional vity illustrates sible strategies accessing the tent within the standards.

- Earth's land surface constantly changes over time.
- Rocks break down into smaller pieces.
- Rocks are broken down through physical and chemical processes such as erosion, weathering, and the effects of the growth of plants.
- Water erosion is one process that reshapes the land.
- Students can differentiate between observation and inference.
- Explanations come from observations and the interpretation of observations.
- Students know what cause-and-effect relationships are.
- Students can make and justify predictions using cause-and-effect principles.
- Students can follow a set of written instructions to perform a scientific investigation.

Notes to the Teacher

In these activities, students observe a variety of sand samples, and based on their observed characteristics, predict the origins of the samples. Aside from what they can learn about sand in particular, they become aware of the utility of keen observation and the idea that small details can yield significant bits of information.

Collecting Sand Samples - Sand can be collected through a variety of simple means. An empty film canister or ziplock bag is perfect for collecting samples. Samples can be collected through your own travels, or through the travels of friends, family members, and students' families. Often teachers have vast collections and are happy to share or swap. The moment a sample is collected, label the sample with the place of collection (be specific), the date collected, and who collected the sample. When collecting volcanic sand samples, note that islands near the continents may be drowned hills or mountains, moraines formed from glaciers, or exotic terrains from transform faulting. Therefore, volcanic sand samples are best collected from islands in the middle of the ocean.

Preparation:

For Part II - Make a sand "sampler" for each group of six students by pouring a small quantity of different sand samples into separate plastic cups. Use more than six different types of sand so that the teams have different combinations of sands, with some samples the same, and some unique. Label the cups with a code that is meaningful to you, but not to your students!

Prepare a reference slide for each sample labeled with the location of collection for each sand sample that is distributed to students.

1. Using a clear-drying glue, smear the glue onto an index card or Petri dish.
2. Sprinkle the sand sample on the glue. NOTE: a thin layer of sand is better than a lot of sand so that the edges of the individual sand grains can be observed.
3. Label the location where the sample was collected.

These reference slides serve as a checking station for students.

For Part III - Make a set of sand slides. As you make each slide, number the slide randomly, and record the number, type of sand, and location of sand, including longitude and latitude for future reference.

Procedures

You Will Need:

Sand samples
Small cups (to distribute sand)
White paper

Index cards or other stiff paper
Colored pencils
Scissors
Scotch or other transparent tape
Hand lens
Microscope(s)
Watershed map
Atlas or detailed map

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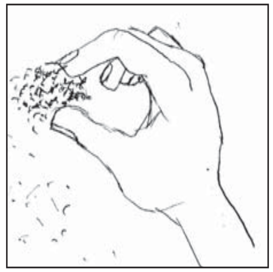
Part 1 An Introduction to Studying Sand (time to teach: 30-40 minutes)



This can be divided into two sections in which students explore the sand in one session, then make the slide and examine it under the microscope in a second session.

1. Give each student a sample of the same kind of sand in a small container.
2. Give students a copy of the student work sheet. Lead them through the questions to help them describe their sand sample.
3. Give students an index card, scissors, and tape to make a sand slide.
4. Students examine their sand slide under each type of microscope available. (*How does each microscope highlight different characteristics of the sand? Which microscope do you think is best to use when examining sand? Why*?)
5. Students use the sand background sheet to determine the type of sand they have.
6. Students examine maps and atlas' to determine potential areas where the sand may have come from.

Part 2 Building Observations and Making Inferences (time to teach: 30-40 minutes)

This lesson can be divided into two parts with the first part examining the sand sampler. The second session would allow students to determine the origin of their sand sample.

1. Give each group of students a sand "sampler" (see preparation).
2. Distribute hand lenses and ask each student to examine one sand sample carefully and describe it on the 3x5 card provided.
3. When the students have finished their descriptions, have them put their 3x5 cards in the center of their table and shuffle the cards.
4. Each group of students rotate to a different set of sand samples and description cards. Their challenge is to match each of the six sand samples with the correct description card. When completed, students should return to their own sand samples and check to see if the description cards were put next to the correct sand sample.
5. Discuss the observable characteristics of the sands examined and how to improve the descriptions.
6. Discuss the origins of sand and ask students how these origins could be reflected by their observations.
7. Distribute a *Sand Data Sheet* to each student and discuss the physical appearance of the different sands (mineral, volcanic, or shell sand). Encourage students to share ideas regarding the appearance of each type of sand.
8. Students complete the *Sand Data Sheet* using their sand "sampler."

Additional Lessons

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standards.

9. Students compare the sand in their “sampler” with others.
10. Display the list of locations where the sand samples were collected and ask the students to guess which location goes with their sand. Record their reasoning.
11. Students use the reference sand slides to check their guesses by comparing their samples with the sand on the slides.

Part 3 Performance Assessment (time to teach: 30 - 40 minutes)

This lesson can be divided into two sessions. In the first session, students find their matching sand samples. In the second session, they find the origin of their sand sample.

1. Prepare a variety of sand slides, each randomly numbered.
2. Tell students that your bag of sand samples are mixed up. You remember making more than one slide from the same sand source, but which slides come from the same beach?
3. Students should plan a strategy for how they will identify the sand samples that come from the same beach.
4. When ready, give students one sand sample to begin. Using the hand lens and microscope(s), students use their strategy to determine which sand slides have sand from the same beach. They should record their work carefully.
5. Once matches for the set of slides are made, each student should be given the longitude and latitude coordinates for their sand sample.
6. Students find the location of the sand source and map a logical path from the source to the beach using what they know about water and wind-driven weathering.

Extensions

- Students bring in sand samples from family trips and create a display board showing some of the sand samples with their source marked on a map.
- Demonstrate how rocks and shells break up to make small grains of beach sand by taking samples of granite, sandstone, or other rock, and using a protective covering, smash them with a hammer. Students observe the resulting pieces. Ask students what natural processes could have the same effect on the samples. Students can use coarse sand paper on pieces of shells to demonstrate how the sand on a beach can wear down shells.
- Students examine some beach sand with particles of different sizes. They weigh the sand before beginning. Challenge them to sort the sand grains using a sieve. Students weigh each set of sifted sand. They graph the percentage composition of the sample, sorted by size.

Sources Used in Developing This Lesson

Kolb, J.A. (1993) FOR SEA – Marine Science Society of the Pacific Northwest, *No Ordinary Sandy Beach*, pg. 373 – 383.

HMSS Fluid Earth, *Unit 2 Waves and Beaches: Sand*, pg. 139-145.

Los Marineros Curriculum Guide: Beaches, Sand Study, pg. 39-42.

Sandy Beach

Background

What is sand? How is it formed?

Hidden on every sandy shore is a mystery waiting to be solved. Where did the sand come from? How far did it travel? What is it made of?

Beaches are formed over thousands of years as mountains are slowly eroded by rains, and rocks break into smaller rocks. Eventually much of this sediment gets washed down rivers and becomes part of a beach as sand. Sand is a commonly found substance, but something few people take the time to look at carefully. Sand is classified by the size of its grains, what it is made of, and where it came from. An arenologist is a marine geologist who specializes in the study of sand. Arenologist comes from the word arena. Greek arenas were once covered with sand. By studying sand, oceanographers and geologists can learn more about the Earth, the oceans, and how the land, wind, and water interact.

Beaches are shaped by the action of waves, winds, and human activity such as dredging, mining, and the presence of dams and breakwaters.

What is sand? Sediment can be defined by its size. The largest sediments are boulders, then gravel, sand, silt, and clay. These sediments can be separated using a sieve, or series of containers that use different size mesh (the largest at the top and smallest mesh at the bottom) to separate sediment by its grain size.

Student Pages

Shape and sediment history

The shape of sand grains is very important because it provides information about the history of the sand. Rough, irregular particles are younger than rounded, smooth ones. Distinctly shaped crystals are rarely found. These rough and sharp edges become rounded and polished through weathering caused by waves, wind, and rain. When wind or waves rub the sediments against each other, they wear down their rough edges into smooth surfaces. Water not only tumbles the sediments but can also change them chemically, dissolving out some substances and changing the nature of the sediment.

There are four common sources for sand: weathering of continental granitic rocks, weathering of oceanic volcanic rocks, skeletal remains of organisms, and grains precipitated from the water. Most sands are formed by the weathering of rocks.

Characteristics

Of course, not all sand is found on beaches. In fact, most of the Earth's sand is found in deserts or buried underground.

Mineral Sand

Mineral sands come from the weathering of rocks that make up the Earth's continental crust. Granite and other igneous and metamorphic rocks form the bulk of the continental crust. Water, along with chemical and temperature changes break down these rocks. When a granite rock is weathered, the rock is broken into smaller pieces. Each of these pieces is usually composed of several minerals. As the weathering process continues, these pieces break down into smaller and smaller pieces until each piece represents an individual mineral. Quartz, the most abundant mineral in these rocks, resists further chemical and physical breakdown, so most sand from a granitic source is quartz. Pure quartz sands are referred to as glass sands and are sometimes used in the production of glass. The quartz sand grains are clear or opaque, but can differ in color depending on the rocks they came from.

Volcanic Sand

Volcanic sands come from the weathering of the earth's oceanic crust. Most of the oceanic crust is made of basalt, a very dark, dense, volcanic rock. The black sand beaches of Hawaii, Tahiti and the Canary Islands are formed from basalt. The sand grains are usually polished obsidian or basalt from nearby volcanoes. Transparent, greenish olivine grains are also common components of oceanic sands.

Shell Sand

Shell sand contains almost exclusively small pieces of shells, coral, or the skeletal remains of animals. Many oceanic organisms possess skeletons made of calcium carbonate or silica. In contrast to sands weathered from granites and basalts that may have traveled thousands of miles from their source, skeletal grains are usually produced near their site of deposition and reflect nearby environments. It is interesting to examine shell sand to find fragments of corals, coralline algaes and mollusks. Although less durable than rock-based sands, many beach sands include skeletal or shell remains. Young skeletal grains still reflect some surface marks characteristic of the organisms from which they came. The degree to which these marks are preserved is an indication of the abrasion the sand has been subjected to and; therefore, an indicator of the age of the sand.

Precipitate Sand

A much less common form of sand is one that precipitates from minerals dissolved in water. In many shallow, tropical areas, warm ocean water enhances the normal rate of precipitation of calcium carbonate. When precipitated, it forms egg-shaped grains called ooids. When cut open, an ooid looks looks a lot like an onion with layers reflecting the gradual development of layers of calcium carbonate.

Far from Origin

Sand far from its point of origin has grains about the same size, no remains of living things visible, and smooth edges on the grains. Grains released by weathering of mineral or volcanic rock may travel great distances before being deposited on a beach. As weathered rock travels down mountains, carried by wind and water, it is subjected to physical and chemical changes. Abrasion causes the grains to become smooth and round. The smoother and rounder the grain of sand, the more abrasion the grain has experienced. What shape grain of sand would you expect to find on a high-energy beach (lots of wave action)?

Near the Origin

Sand that is near to its source of origin tends to have skeletal remains visible, many different size mineral grains, and grains that are sharp, rough, or coarse.

Name:

Sandy Beach

Part 1 What is Sand?

1. When your teacher gives you a sample of sand, carefully pour some of the sand into your hand. Describe what the sand feels like.

2. Describe what the sand smells like.

3. Rub a small pinch of sand gently between your fingers. Describe what it feels like.

4. Rub a small pinch of sand firmly between your fingers. How is this different from when you rubbed it gently?

5. Pour the sand onto a clean, white, piece of paper. Draw what the sand looks like.

6. Look at the sand using a hand lens. What else can you see about the sand?

7. Do all the sand grains look the same? If not, how are they different?

8. What is your sand made of (e.g. rocks, shells, etc.)

9. Draw your sand sample as viewed through the hand lens.

Student Pages

Name:

10. Do you think your sand is old or young? What evidence could you use to support your inference?

11. Use the index cards, tape and scissors to make a sand slide.

12. Examine your sand slide under each type of microscope available. Draw what you see under each microscope.

Type of Microscope:	Type of Microscope:
Type of Microscope:	Type of Microscope:

13. How does each microscope highlight different characteristics of the sand?

14. Which microscope do you think is best to use when examining sand? Why?

15. What type of sand is your sample? How do you know?

16. Where do you think the sediment came from that created the sand you are examining?

17. How did these particles get to be on the same sandy beach?

Student Pages

Name:

Sand Data Sheet

Part 2 **Comparing Sand**

	Mostly mineral sand	Mostly volcanic sand	Mostly shell sand	Near or far from origin sand
Physical Appearance				
Observations				
Inference				

This sand sample was collected from
(check the list of locations where these sand samples were collected) ____________________

I think my sample was collected here because... ____________________

____

What did you successfully infer about your sand sample?

____

____

Student Pages

Name:

Sand Data Collection

Part 3 **Where is my sand from?**

Explain your strategy for determining which sand is from the same beach:

On a separate sheet of paper, choose one of your sand slide sets.

1. Identify slide numbers for sand from the same “sandy beach.”
2. Draw sand:
3. Identify the type of sand:
4. Identify where the sample came from.
5. Explain how the sand from your sample got to your “sandy beach.” Explain your answer thoroughly based on your knowledge of the rock cycle.

Sand Slide Number	Drawing of Sand	Type of Sand	Longitude	Latitude	Source Location

Student Pages

Earth's Surface Constantly Changes

My notes

Introduction

The *Earth's Surface Constantly Changes* unit is focused on the rapid and slow processes that change Earth's landscape. This unit provides students with an opportunity to examine the impact of rapid changes to the landscape such as landslides, volcanic eruptions, and earthquakes, as well as examining slower processes that affect rock such as erosion, weathering, freezing, and thawing, and the growth of roots.

This unit looks at changes to the Earth's crust at both large and small scale. Students' familiarity with the basic geography of oceans and continents will be very helpful. Some students may also need examples of how rivers, streams, and the ocean can change the surrounding landscape. News clips following rains and videos of volcanic eruptions and earthquakes can be very helpful to build a visual image from which students can contextualize the science content they are learning. When students are in Grade 6, the foundation set during Grade 4 will develop into a more global understanding of the processes that are explained by plate tectonics and the theory of continental drift.

Across Los Angeles there are many resources to support an enriched study of Earth's processes. The city's museums have quality exhibits on earthquakes, volcanic eruptions, and the effects of erosion and weathering. For a list of district-approved field trips and assemblies, review LAUSD publication GC-148, pg. 35-67. This publication also includes necessary LAUSD bulletins on transportation, safety, and other issues related to field trip excursions.

California Academic Content Standards –This unit focuses on content standards 5a – 5c, with significant support for building science process skills in I&E standard 6a, 6c, and 6d.

California Academic Content Standards:

5a. 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.

5b. Students know natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.

5c. 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).

6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6c. Formulate and justify predictions based on cause-and-effect relationships.

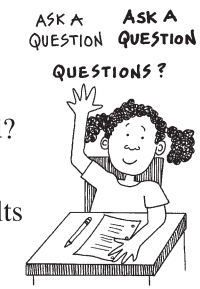
6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

Vocabulary –The core vocabulary for the *Earth's Surface Constantly Changes* unit focuses on ways to describe the cause and movement of Earth's materials. Additional vocabulary reflects terminology students may have been introduced to in Grade 2 and terms that they will become familiar with as a result of erosion and weathering activities. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons –The additional lessons for this unit are: *Physical and Chemical Weathering* and *Glacier Erosion*.

MY notes

Critical Questions



- What evidence do scientists have that the Earth is constantly changing?
- What are different ways that rock is eroded?
- Of the many slow and rapid processes that affect the surface of the Earth, which results in the greatest change to Earth's surface over long periods of time?

Connections

The following are optional connections that can be made across the curriculum. Specific standards citations for these connections can be found in the publisher's materials chosen for instruciton.

Language Arts: Students learn a number of vocabulary terms in this unit. As a part of this study, students find that in science, terms were developed to describe phenomenon. Students will also practice reading different types of text, and respond to this text in oral settings.

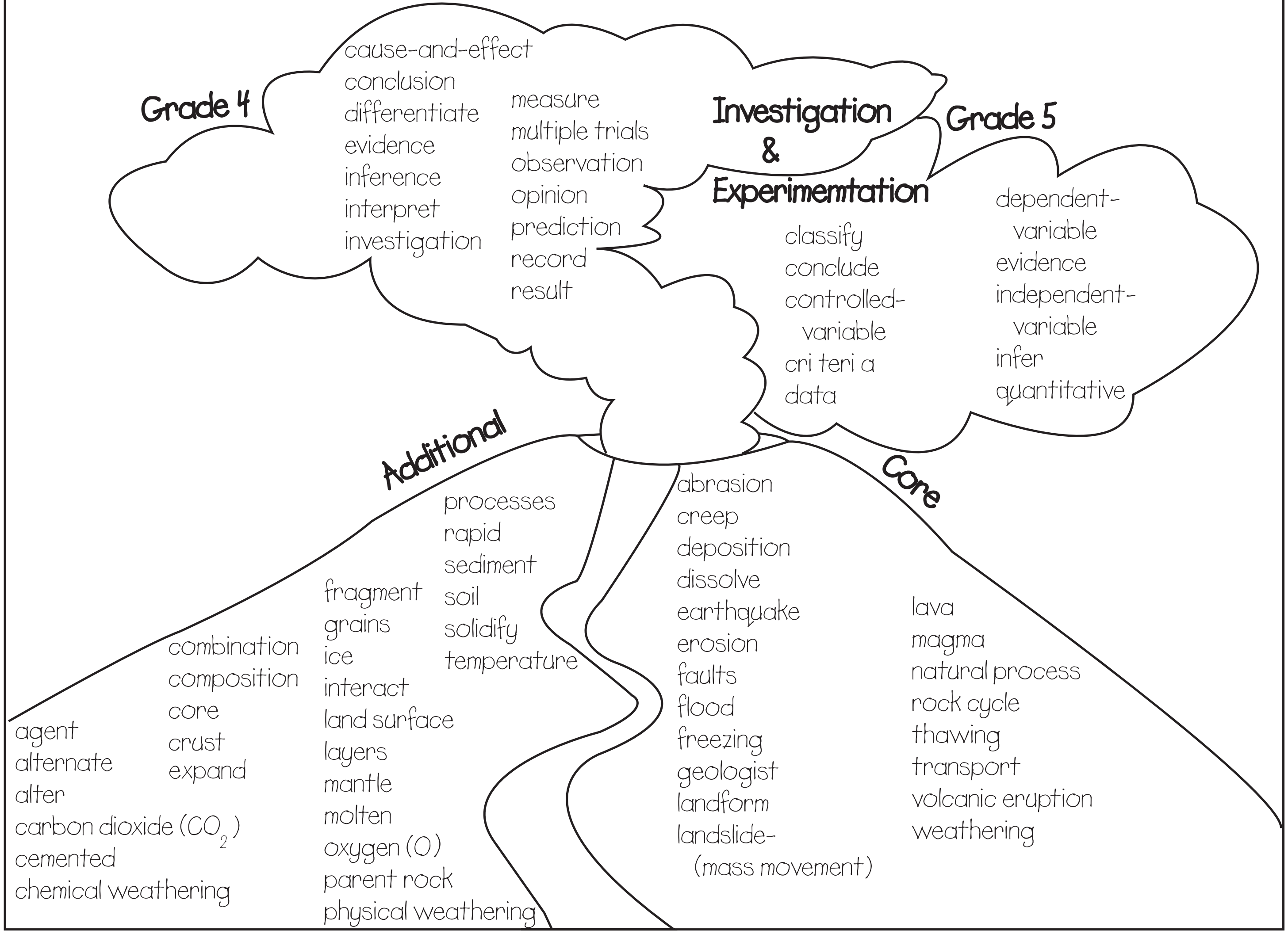
History–Social Science: Students may make connections between the content of this unit and their understanding of the geography of California, and how this geography influenced where people live, the economic base of the State, and how people traveled during the Westward movement.

Background

Due to the challenges of finding time to teach science in the classroom, finding the time to perform multiple trials for experimentation can be difficult (a component of standard 6d). One way to have students perform multiple trials is to have many students (or cooperative groups) within the classroom perform an experiment under the same conditions so that each set of data can be used as an experimental trial. The class can compile the data and use it to build validity and reliability for their conclusions.

> *"Discovery consists of seeing what everybody has seen and thinking what nobody has thought."*
>
> *- Albert Szent-Gyorgyi, in* *The Scientist Speculates* *(1962)*

Grade 4 Vocabulary
Earth's Surface Constantly Changes



California Academic Content Standards:

5a. 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.

5b. Students know natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.

5c. 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).

6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

MY notes	HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL *** Resources are organized by topic**		MY notes
	RESOURCE	**NOTES**	**RESOURCES**	**NOTES**	
	Chapter 1 • Lesson 1, *What Processes Change Landforms?* pg. B4-11 • WB 76-77 • Investigative Challenge, p. B10 • Lesson 2, *What Causes Mountains, Volcanoes, and Earthquakes?* pg. B12-19.	• Many concepts in this lesson connect with ideas that will be further developed in Grade 6. • Focus on the effect of water on the Earth's surface. • Many concepts in this lesson connect with ideas that will be further developed in Grade 6.	**Chemical and Mechanical Weathering** The Amazing Earth Model Book • *Rocks Under Attack*, pg 60 – 66 • *Glaciers*, pg. 94-99 **Rock Formation** The Amazing Earth Model Book • *Volcanic Rocks: A Field Guide*, pg. 32 – 36 • *Sedimentary Rocks*, pg.37 - 43	• The role of glaciers in weathering rock • Provides examples of volcanic rock • Provides examples and models of sedimentary rocks	

My notes	HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL * Resources are organized by topic		My notes
	RESOURCE	**NOTES**	**RESOURCES**	**NOTES**	
	Chapter 3 • Lesson 1, *How Does Soil form?* pg. B62-67. • Activities for Home or School: *Weathering Rock*, p. B57	• B1-2 can replace *Journey to the Center of Earth*, B12-13, if you have students allergic to peanuts. • To understand the discussion on the relationship between earth's crust and rocks, students need to know the geography of oceans and continents. • Emphasize volcanoes, earthquakes, and how soil is formed from rock.	• *Metamorphic Rocks*, pg.44 – 49 **Rock Cycle** The Amazing Earth Model Book, • The Rock Cycle, pg. 55 - 59 GEMS: Stories in Stone, • Session 5: Formation of Sedimentary Rock, pg. 65-73 • Session 6: Formation of Metamorphic Rocks, pg. 75 – 80	• Provides examples and models of metamorphic rocks • A "wheel" model of the rock cycle • The role of weathering in the formation of sedimentary rocks • Provides examples and models of metamorphic rocks	

If using the *Harcourt Science* program, the lessons listed below provide the needed support for student access to the identified content standards for this unit. These resources are provided within this *Guide*.

MY NOTES	RESOURCES IN THIS GUIDE	NOTES
	• Physical and Chemical Weathering, pg. 180 • Glacier Erosion, pg. 182	• A demonstration of the difference between physical and chemical weathering. • The role of glaciers in the erosion of rock.

S t a n d a r d s A l i g n m e n t

Source	Description	Pages	Standards Supported in this Unit										Notes
			ES 4a	ES 4b	ES 5a	ES 5b	ES 5c	6a	6b	6c	6d	6e	
GEMS: Stories in Stone	Session 5: *Formation of Sedimentary Rock*	65 – 73				▼							A hands-on activity in which students' model how sedimentary rock is formed.
	Session 6: *Formation of Metamorphic Rocks*	75 – 80	▼										A hands-on activity in which students' model how metamorphic rock is formed.
Harcourt, Chapter 1, Lesson 1	How Water Changes Earth's Surface	B4-5			▼		▼	▼		▼			A simulation of how moving water can affect Earth's surface. Requires a stream table.
	Investigate Log	WB 76 - 77			▼		▼	▼		▼			To accompany *How Water Changes Earth's Surface* on pages B4-5.
	Changes to Earth's Surface	B 6 – 11			▼	▼	▼	▼					Cooperative groups work well to jigsaw this text. Students may need larger images
	Investigative Challenge: *More About Earth's Forces*	B 10			▼	▼	▼	▼		▼			A research activity in which students collect graphic images of weathering processes.
Harcourt, Chapter 1, Lesson 2	Mountains, Volcanoes, and Earthquakes	B 14 - 19			▼								Text Page 14 connects to grade 6: 1b; page 15 connects to grade 6: 1a; pages 14 and 15 require students know the geography of oceans and continents; page 16 connects to grade 6: 1b; images on page 17 connect to grade 9-12 ES: 3c
	Activities for Home or School: *Weathering Rock*	B57	▼		▼	▼	▼	▼		▼			An activity to observe the effect of water on a "soft rock".
Harcourt, Chapter 3, Lesson 1	Soil Formation	B 65 – 67				▼							Text

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Source	Description	Pages	Standards Supported in this Unit										Notes
			ES 4a	ES 4b	ES 5a	ES 5b	ES 5c	6a	6b	6c	6d	6e	
Additional Lesson in this Guide to support the Harcourt Program	Physical and Chemical Weathering	Guide, page 180				▼							A demonstration on the distinction between physical and chemical weathering.
	Glacier-driven Erosion	Guide, page 182		▼	▼	▼	▼		▼		▼	▼	A series of activities in which students model the role of glacial ice in erosion.
The Amazing Earth Model Book	Glaciers	94 – 99				▼							A simulation that models how glaciers erode rock.
	Metamorphic Rock	44 – 49			▼								Students make a model of metamorphic rock and research examples of metamorphic rock
	Rock Cycle Model	55 - 59			▼								Students make a concept map of the rock cycle
	Rocks Under Attack	60 – 66			▼								Students use concept maps to show the effects of weathering on rocks
	Sedimentary Rocks	37 – 43			▼								Students simulate sedimentary rocks and do create a field guide on samples of sedimentary rocks
	Volcanic Rocks	32 – 36			▼								Students simulate volcanic rocks and create a field guide on samples of volcanic rocks

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

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Physical and Chemical Weathering

Science Standards

5b. Students know natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.

Focus Concepts

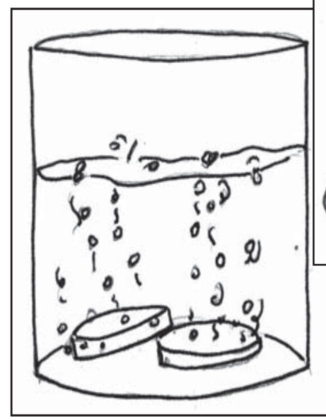
- Rocks are broken down through physical and chemical processes such as erosion, weathering, and the effects of the growth of plants.

Purpose

To illustrate the difference between mechanical (physical) and chemical processes.

Background

Physical weathering is caused by forces such as percussive action (rocks hitting each other), wind, and water. Chemical weathering is caused by a reaction between two substances, such as acid rain, or acids excreted by plant roots that dissolve rock. Differentiating between (mechanical) physical processes and chemical processes that affect rocks can cause students confusion. With a simple demonstration, students can have a clear image of the difference between mechanical and chemical processes.



Procedures

You will need:

Alka-seltzer tablet (or similar generic)
Bag or box
Hammer
Clear cup of water

As a part of the discussion on the rock cycle, students examine the many ways that rocks break into smaller and smaller pieces. <u>Mechanical or physical processes</u> include water and wind erosion, freezing, and thawing. These processes break the rock into smaller sediments, but the rock pieces still have the same ingredients as the "parent rock." This can be illustrated by taking a piece of alka-seltzer (or generic) and putting it into a bag or a box (for safety from flying shards) and hitting it with a hammer. The hammer will break the tablet into smaller

Additional Lessons

This sample instructional activity illustrates possible strategies for accessing the content within the standards.

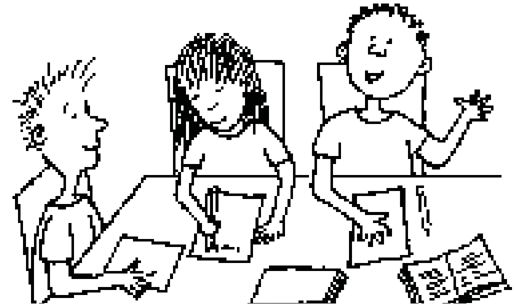
pieces, but each piece still retains the same characteristics as the original.

Sometimes, rock undergoes a chemical change through contact with acid rain, or oxidation (reaction with oxygen in the atmosphere). When the acid reacts with the rock, the rock is changed. This is similar to taking a piece of the Alka-seltzer tablet and dropping it into a clear cup of water. Students can watch the tablet piece dissolve as carbon dioxide "fizzes." Similarly, by dropping vinegar on limestone or calcite, carbon dioxide is released (this too can be demonstrated, but the bubbling will not be dramatic).

Plants break rocks through mechanical and chemical processes. Plant roots can secrete acids that break down rocks, weakening their structure and allowing the plants to grow between the cracks they form. As the plants grow, the roots get thicker, creating a wedge in the rock until it breaks. The small pieces of rock that are cast aside mix with decaying plant (organic matter) to make soil.

Discussion Starters

- Does the property of a rock change when it is split apart or broken?
- How is a chemical change different from a mechanical change?
- What are some ways that plants can affect rocks?
- Are acid rain and oxidation mechanical or chemical changes? How do you know?



Additional Lessons

'his sample nstructional vity illustrates sible strategies accessing the tent within the standards.

Glacier-driven Erosion

Science Standards

4b. 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.

5a. 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.

5b. Students know natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.

5c. 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).

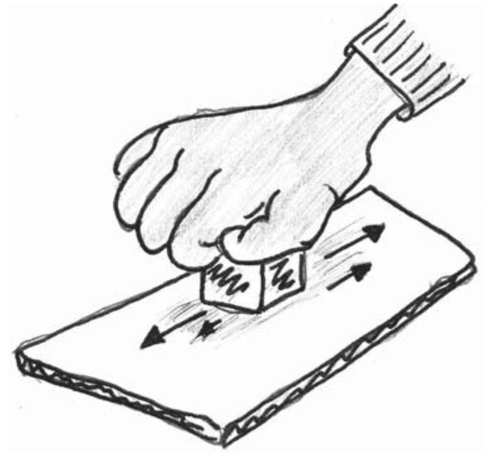
6b. Measure and estimate the weight, length, or volume of objects.

6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

6e. Construct and interpret graphs from measurements.

Focus Concepts

- Some properties (hardness, cleavage, color, and streak) are used within a table of diagnostic properties (Mohs Hardness Scale) to identify common ores and minerals.
- Common ores and minerals can be identified by the properties of hardness, cleavage, color, and streak.



- Some reshaping processes are slow and some are rapid.
- Rocks break down into smaller pieces.
- Landforms are reshaped by water erosion and weathering.
- Water erosion is one process that reshapes the land.
- Students know how to measure and estimate the weight, volume, and length of objects.
- Students will be able to perform multiple experimental trials.
- Students know the difference between a prediction, a result, and a conclusion.
- Students can use the results of multiple trials to test a prediction and draw conclusions.
- Students can use measurements to construct a graph.
- Students can interpret graphs.

Purpose

To demonstrate the role of glaciers in erosion.

'his sample ıstructional vity illustrates ;ible strategies accessing the tent within the standards.

Background

When most substances are squeezed by pressure, they become denser solids or break into pieces. When ice is squeezed, it too becomes denser, but by turning into a liquid. This principle works with glaciers. Glaciers are large masses of moving ice. They form in very cold places where winter snow does not fully melt from one year to the next. After years of ice and snow piling up and pressing on the ice beneath, the weight causes the bottom layers to melt from the pressure. These layers refreeze as grainy ice as the pressure is released. Over time, this grainy ice becomes rough and hard. It thickens, and as gravity acts on the glacier, it begins to move downhill under its own weight. This slow-moving glacier may be thought of as a river of ice. As the glacier moves downhill, rocks are pried loose. They act as cutting tools, eroding the land beneath the glacier. Glaciers can cut through valleys and cut away mountains. As the glacier continues to move, a mound of debris will be pushed along in front of it. This debris can be as large as boulders, or as small as clay.

Procedures

This activity is divided into 3 parts. In the unit *Rocks and Minerals* the idea of ice as a mineral is discussed. This is an opportunity for students to determine some of the properties of ice as a mineral. Part 2 allows students to explore the role of glaciers (using an ice cube as a model) in weathering. Part 3 is an opportunity for students to practice measurement and design their own experiment. Each part can be implemented without the others. Selection should reflect instructional goals and needs of specific learners.

Part 1

What are some properties of ice? (time to teach: 20 minutes)

You will need:

Ice cubes
Hardness Kit (set of minerals)*
Mohs Hardness Scale (in the Harcourt text or the Elementary CST Reference Sheets)
Gloves or towels (to protect students' hands from the ice)

* These minerals can be checked-out from the District Math/ Science/Technology centers

Students have determined the hardness of various minerals in the *Rocks and Minerals* unit. Now they can determine the hardness of ice.

1. Ask students to predict the hardness of ice, based on their experience with the hardness kit.
2. Ask students to explain how they will determine the hardness of ice.
3. Ask students to predict whether ice has cleavage and if so, the number of planes. (*Note: ice cubes, formed by their container, may lead some students to believe that ice cubes have cleavage.*)
4. Ask students how they could determine the cleavage of ice.
5. Give students the materials and let them follow their procedures to determine the hardness and cleavage of ice.
6. Have students compare their results by charting them on a chalkboard or whiteboard. Discuss any differences and retest if needed so that the group comes to consensus.

Discussion Starters

- What are some ways water and ice can affect rocks?
- Under what circumstance is ice considered a mineral?
- Based on the properties of ice, why do glaciers play a role in reshaping landforms?

'his sample nstructional vity illustrates sible strategies accessing the tent within the standards.

Part 2 A Model Glacier (time to teach: 20 minutes)

You Will Need:

Ice cubes
Sand
Newspaper pages
Dish, bowl, or pan
Gloves or towel (to protect students' hands from the cold)

Preparation

1. Make ice cubes that are large enough that a student can grip it easily.
2. Place the ice cubes in a dish, bowl, or pan of sand. Let them stand at room temperature for a few minutes, then put the entire dish in the freezer overnight.
3. Just prior to the lesson, remove the dish from the freezer. You may have to separate the cubes using a towel or glove.

Procedures

1. Give each student a prepared ice cube (you may want to give students gloves or a towel so they can hold the ice cube more easily).
2. Have students examine their *glacier* and describe it.
3. Ask students to predict the results when they rub their *glacier* over the newspaper pages.
4. Have students rub the *glacier*, sand side down, over the newspaper pages.
5. Discuss what happened.

Discussion Starters

- How is your ice cube like a glacier?
- How does your glacier affect the landscape it travels across?

Part 3 Measuring Glaciers (time to teach: 40 minutes in 2 parts)

You Will Need:

Ice cubes
Graphing materials
Sand
A balance
Dish, pan, or bowl
Ruler
Gloves or towel (to protect students' hands from the cold)
Sidewalk chalk

Day 1

1. Ask students if all glaciers erode the same amount of sediment. (No)
2. How could we test the relationship between glaciers and the amount of erosion? (Students will determine variables such as: size of ice cube, amount of sand, amount of sandy surface in contact with the Earth's surface, weight of glacier, type of soil beneath the glacier, etc.)
3. Choose the variables your class would like to test.
4. Prepare the ice cubes to reflect the variables to be tested.

Additional Lessons

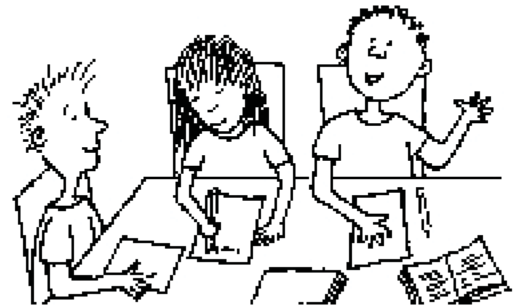
This sample nstructional vity illustrates sible strategies accessing the tent within the standards.

Day 2

1. Write out a list of procedures with your students to test each variable.
2. Give students a piece of sidewalk chalk (representing rocks and soil beneath the glacier). Have students weigh and measure their chalk to find out its measurements before the *glacier* acts on it.
3. Have students predict what they think will happen to the ice cube and chalk in their test.
4. For each variable to be tested, determine a group of students who will focus on the test for that variable. Students may need to weigh their *glacier* or measure it to determine its length and volume. Students will need to do their measurements quickly so their ice cube doesn't melt too much in the process (gloves or towels will not only protect students' hands but will also slow the melting process by protecting the ice from students' warm skin).
5. Allow students time to complete their test and record their results.
6. Have students examine the results from others who performed the same test. Ask them about variations in their results and what might account for these differences.
7. Have students report to the class the results of their test and what information this tells them about glaciers.
8. Based on the results of all groups, have the class form conclusions about the role of glaciers in rock erosion.

Discussion Starters

- Why did you measure the ice cube and chalk before and after your experiment?
- What type of rock does the chalk represent?
- What other variables could you test to determine the relationship between glaciers and rock erosion?



Sources Used in Developing This Lesson

Silver, Donald M., Wynne, Patricia J., The Amazing Earth Model Book, *Glaciers: Grow and Melt a Glacier*, Scholastic. Pg. 94 – 99.

Module Planning Calendar

This optional planning tool is provided to assist in personal and shared instructional planning. Space is provided to record the unit of instruction, selected published resources, and possible classroom assessments for each week of the Module. Circle the days of the week for instruction (M, T, W, Th, F) and note the lessons for implementation in the space provided.

Grade: ____________ **Teacher(s):** ____________________ **Trimester:**

1	**Unit of Instruction:**	**Selected Resource(s):**	**Assessment:**	**2**	**Unit of Instruction:**	**Selected Resource(s):**	**Assesment:**
M T W Th F				M T W Th F			
3	**Unit of Instruction:**	**Selected Resource(s):**	**Assessment:**	**4**	**Unit of Instruction:**	**Selected Resource(s):**	**Assesment:**
M T W Th F				M T W Th F			

Developed based on design by Diana Roston, LAUSD teacher.

Module Planning Calendar

Week	Unit of Instruction:	Selected Resource(s):	Assessment:
5			
M T W Th F			

Week	Unit of Instruction:	Selected Resource(s):	Assesment:
6			
M T W Th F			

Week	Unit of Instruction:	Selected Resource(s):	Assessment:
7			
M T W Th F			

Week	Unit of Instruction:	Selected Resource(s):	Assesment:
8			
M T W Th F			

Week	Review and Periodic Assessment
9	
M T W Th F	

Week	Review and Periodic Assessment
10	
M T W Th F	

Developed based on design by Diana Roston, LAUSD teacher.

Grade 4 Physical Science

My notes

Introduction

In Grade 4 physical science, students deepen their understanding about electricity and magnetism in a more systematic effort to develop the principles of each and begin to examine how they are inter-related. Students explore applications of electricity and magnetism to their everyday life and build a foundation for studies in high school.

The California Content Standards in Science were designed to spiral the content so that topics introduced in Grades K-3 are presented with increasing depth and complexity in Grades 4-5, 6-8, and again in Grades 9-12. Each time the topic spirals, students can draw upon what they learned before and add increasing depth to their understanding of the world around them.

Articulation: In Kindergarten, students first explore the idea of magnetism. In Grade 2, they return to magnetism to explore the push / pull force, the polarity of magnets, and how objects can be moved using a magnet. In Grade 3, students begin to formally explore electricity, understanding that electricity is charged particles moving through a wire and that this energy can be converted to motion and heat.

The content for Grade 4 deepens students' understanding of previously learned material, and prepares them for deeper study of forces in Grade 8, and specific principles of electricity in high school.

This module of the *Instructional Guide* is designed to provide teachers with a variety of resources to support implementation of the Grade 4 physical science content standards. The module is organized into sections:

- The content standards
- Vocabulary
- Periodic Assessment
- Immersion unit
- Units of instruction
- Module Planning Calendar

The content standards – All physical science and Investigation and Experimentation standards are supported in this module. A list of the standards is provided in the document *Key Knowledge and Concepts*. In this document, each standard is described by its major concepts as explained by the *2003 California Science Framework*. The following units of instruction include a list of the specific standards supported by that unit. The same standard may be supported by more than one unit, as many standards are multifaceted and should be addressed through a variety of contexts.

Vocabulary – The module provides a vocabulary list of all vocabulary for Grade 4 Physical Science. Each unit of instruction also includes a vocabulary list in graphic form, depicting the terminology supported by that unit. This *Guide* supports students' acquisition of the language of science. **It should be noted that although vocabulary is important to learning the language of science, knowing the definitions of scientific terminology is not the same as knowing the science concepts.**

Each vocabulary list is divided into three major sections: Core, Additional, and Investigation and Experimentation. <u>Core Vocabulary</u> refers to terminology all students should master as a result of instruction. <u>Additional Vocabulary</u> refers to terms

My notes

that some students may not yet know, such as those who did not have a standards-based science program in Grades K-3. The Investigation and Experimentation (I&E) Vocabulary includes terms from both Grades 4 and 5 so that teachers can introduce ideas to be mastered in Grade 5 while developing an understanding of the processes to focus on during Grade 4.

Immersion Unit – The Immersion Unit for this module is a study of magnetism and electromagnetism in which students explore scientific phenomenon, testing their predictions and collecting data to support their conclusions. To culminate the unit, students apply their understanding of magnetism to create models that explain how permanent and temporary magnets work. Students should have completed their study of electricity before beginning this Immersion Unit.

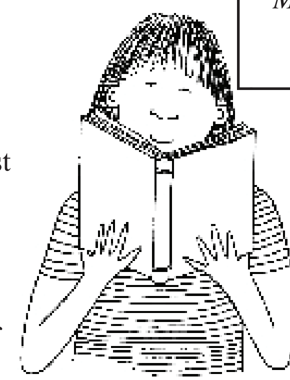
Units of Instruction – The units of instruction for Grade 4 physical science include: *Electricity*, *Magnetism*, and *Electricity and Magnetism*. Each unit introduction explains the focus for the unit, the content standards supported, and teacher background. Each unit includes a listing of the standards, published resources, and vocabulary that relate to the unit. Published resources are provided in two formats. The first chart shows the resources from the *Harcourt Science* text and any needed additional lessons in the left column, and a list of supplemental programs listed by topic on the right. The second chart lists each resource, by publisher, with page-specific standards alignment and teacher notes. **These charts provide an extensive list of resources to support instruction of the content. It is not expected that teachers will use all the resources, but will choose from those provided as a foundation for teaching the content in the standards.**

Additional Lessons – Teachers using the *Harcourt Science* program will need to supplement their program to ensure that students have access to all the content in the standards. Teachers may choose from the supplemental resources provided on the Resources Chart, or the *Immersion Unit* to provide this needed support. Recognizing that not all supplemental resources are accessible to all classrooms, the specific content and skills that need additional support have been organized into lessons and are provided in this *Guide*. Within the Grade 4 Physical Science Module, all three units include additional lessons to support the *Harcourt* program.

Module Planning Calendar – A planning calendar is provided to assist teachers in mapping out their use of instructional resources including the *Immersion Unit*, *Harcourt Science*, and other supplemental materials as selected. For each week of instruction, space is provided to list the name of the unit of instruction, selected resources, and potential assessments to be used. It is recognized that science may not be taught each day, but rather shorter or longer time blocks may be organized to better fit with the teacher's overall instructional schedule. Space is provided to reflect this flexibility in scheduling instruction, yet also to give the teacher an overview of the instructional module to ensure that students have access to all the content in the standards prior to implementation of a periodic assessment.

Background

When students take the California Standards Test (CST) in Grade 5, the test will include each of the Grade 4 standards in addition to all but one of the Grade 5 standards (standard 3e). In examining the test blueprint, seven (7) items on the test will be aligned with the Grade 4 Physical Science standards. Since all Grade 4 standards will be tested with at least one question, students should have a foundational understanding of the content in each of the Grade 4 physical science standards.



"One aim of the physical sciences has been to give an exact picture of the material world. One achievement of physics in the twentieth century has been to prove that that aim is unattainable."
- Jacob Bronowski, The Ascent of Man (1973)

Grade 4 - Physical Science Content Standards	Key Knowledge and Concepts from the California Science Framework
1a. Students know how to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.	• Wires, batteries, and bulbs can be used to design and build an electrical circuit. • The two basic types of circuits are series circuits and parallel circuits.
1b. Students know how to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.	• A compass can be made from simple materials and a magnet. • A compass can be used to detect magnetic fields. • The Earth has a magnetic field.
1c. Students know electric currents produce magnetic fields and know how to build a simple electromagnet.	• Electric currents produce magnetic fields. • Wires, an iron core, and a battery can be used to build a simple electromagnet. • An electromagnet has two poles and these poles can be reversed.
1d. Students know the role of electromagnets in the construction of electric motors, electric generators, and simple devices, such as doorbells and earphones.	• Many simple devices use electromagnet. • Electromagnets use electrical energy to make things work.
1e. Students know electrically charged objects attract or repel each other.	• Charged objects repel or attract each other. • Static electricity occurs with the gain or loss of electric charges.
1f . Students know that magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.	• Magnets have two poles, and they may be called North and South, or positive and negative (+, -). • Like poles repel and unlike poles attract.
1g. Students know electrical energy can be converted to heat, light, and motion.	• Electrical energy can be converted to heat and light through resistance in wires. • Electrical energy can be converted to motion using devices such as an electromagnet or electric motor. • Wires are insulated to protect from heat generated by electrical energy or to keep the electric current traveling in the desired direction.

Grade 4 - Science Content Standards Investigation and Experimentation	Key Knowledge and Concepts from the California Science Framework
6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.	• Students can differentiate between observation and inference. • Explanations come from observations and the interpretation of observations.
6b. Measure and estimate the weight, length, or volume of objects.	• Students know what weight, length, and volume represent. • Students know how to measure and estimate the weight, volume, and length of objects.
6c. Formulate and justify predictions based on cause-and-effect relationships.	• Students know what cause-and-effect relationships are. • Students can make and justify predictions using cause-and-effect principles.
6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.	• Students will be able to perform multiple experimental trials. • Students know the difference between a prediction, a result, and a conclusion. • Students can use the results of multiple trials to test a prediction and draw conclusions.
6e. Construct and interpret graphs from measurements.	• Students can use measurements to construct a graph. • Students can interpret graphs.
6f. Follow a set of written instructions for a scientific investigation.	• Students can follow a set of written instructions to perform a scientific investigation.

Grade 4 Physical Science Vocabulary

Additional

- aligned
- alternate pathways
- axis
- circular
- coil
- components
- convert
- detect
- devices
- electrical energy
- electrically charged
- electricity
- electronic devices
- flow
- heat
- magnetic force
- magnetized
- motion
- north
- open/closed circuit
- pathways
- poles
- rotation
- short circuit
- south
- vibrate

Core

- attract
- circuit
- conductor
- current
- electric cell
- electrically charged
- electric field
- electromagnet
- insulation
- magnetic fields
- negative charges
- parallel circuit
- positive charges
- repel
- resistance
- series circuit
- static electricity

Electricity Terminology

- battery
- bulb
- circuit breaker
- coil
- electric generator
- electric motor
- filament
- fuse
- grounded object
- insulated wire
- switch
- wire

Magnetism Terminology

- compass
- compass needle
- iron
- magnet

Grade 4 Investigation & Experimentation

- cause-and-effect
- conclusion
- differentiate
- evidence
- inference
- interpret
- investigation
- measure
- multiple trials
- observation
- opinion
- prediction
- record
- result

Grade 5 Investigation & Experimentation

- classify
- conclude
- controlled variable
- criteria
- data
- dependent variable
- evidence
- independent variable
- infer
- quantitative

My notes

Core Vocabulary - Defined

This *Guide* supports students learning the academic language of science. Sample definitions for each core vocabulary term are provided as a resource. Using the language of science is important to help students learn both the process and the content of science, but simply knowing the definitions of scientific terms is not the same as knowing important science concepts. By giving students the opportunity to use academic language in the greater context of instruction, including oral discourse and a variety of print, students will become comfortable recognizing and using these terms as they do science.

General Terms

attract - When two unlike poles or charges are placed close together and are pulled toward each other.

circuit - A path that is made for an electric current.

conductor - A material that electric current can pass through relatively easily.

current - The flow of electricity.

electric cell - A device that supplies energy to move charges through a circuit.

electrically charged - A measure of the extra charged particles that an object has.

electric field - The space around an object in which electric forces occur.

electromagnet - A circuit with wire wrapped around an iron core that generates a magnetic field.

insulator - A material that electric current does not pass through easily.

magnetic field - The space around a magnet in which lines of force occur that extend between a magnet's north and south poles.

negatively charged - When an object's charged particles are not equal, and there are more negative charges than positive charges.

parallel circuit - A circuit with more than one path for electric current.

positively charged - When an object's charged particles are not equal, and there are more positive charges than negative charges.

repel - When two like poles or charges are placed close together and they push each other apart.

resistance - When a circuit, or some part of a circuit does not allow electric current to flow easily.

series circuit - A circuit with only one path for electric current.

static electricity - When an object is electrically charged in comparison with its surroundings. The object may gain or lose negatively charged particles to equalize the electric charge.

Electricity Terms

battery - One or more connected electrical cells that produce electric current through the conversion of chemical energy into electrical energy.

bulb - A source of artificial light in the form of a glass case containing a filament that emits light when an electric current is passed through it.

circuit breaker - A device that can stop the flow of electricity in a circuit if there is too much current to operate safely.

MY notes

coil - A series of loops into which something has been wound or gathered.

electric generator - A device that converts energy of motion (mechanical energy) into electric current for conversion into heat, light, or motion.

electric motor - A machine that converts energy from electricity into energy of motion (mechanical energy).

filament - A thin material, that when an electric current is passed through it, becomes hot (and glows brightly in a light bulb).

fuse - An electrical safety device containing a piece of a metal that melts and breaks the circuit if the current running through it exceeds a certain level.

grounded object - An object that has an alternate route for the removal of excess electricity. A building with a lightening rod is an example of a grounded object.

insulated wire - A covering to prevent or reduce the unwanted transfer of heat or electricity from the wire to the surroundings.

switch - A device that opens, closes, or changes the connections in an electrical circuit.

wire - Metal in the form of thin flexible strands that carries an electrical current (usually encased in plastic or another insulating material).

Magnetism Terms

compass - A device used to determine direction (north, south, east, west), using the Earth's magnetic field as a reference.

compass needle - A thin, magnetized object within a compass that aligns itself with Earth's magnetic field.

iron - A common metallic element that is easily magnetized, is malleable, ductile, and is represented by the atomic symbol Fe.

magnet - An object that has a magnetic field and thereby attracts certain materials, usually objects containing iron.

MY notes

Periodic Assessment

As an integral element of the *Elementary Periodic Assessment Program*, the Grade 4 science assessments are designed to provide teachers and the LAUSD with the diagnostic information needed to ensure that students have received instruction in the science content specified by the California Academic Content Standards, and to provide direction for instruction or additional resources that students may require in order for students to become proficient in science at their particular grade level.

Results from the *Periodic Assessments* should be used to inform immediate adjustments and guide modifications in instruction to assist all students in meeting or exceeding the content specified by the state's science content standards.

At the conclusion of this *Instructional Unit*, students will take a *Periodic Assessment*. This assessment of the student's accomplishment of the standards within the science discipline should not be considered the sole method of assessing students' content knowledge for this unit.

Calendar

Each *Periodic Assessment* will consist of multiple-choice and possibly open response questions. Each of the three annual assessments will be scheduled within a testing window at approximately 10-week intervals. A calendar for assessment administration will be made available at the beginning of the academic year. Schools can choose the order of assessment implementation to reflect the order in which the science *Standard Sets* are taught. In making this decision, consider the local issues regarding materials use and storage and needs for professional development.

Blueprint

The following *Periodic Assessment* blueprint shows the design for the Grade 4, Physical Science *Periodic Assessment*. The assessment will consist of 25 questions, with 10% of the questions assessing the Investigation and Experimentation standards. The remaining items will assess student knowledge of the physical science content standards. This blueprint was developed to reflect the focus of the Elementary California Standards Test at Grade 5 in which almost all standards (Grades 4 and 5) are assessed.

Periodic Assesment Blueprint

Standards	# Items
1. Electricity and magnetism are related effects that have many useful applications in everyday life. As a basis for understanding this concept:	22 items
1a. Students know how to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.	4
1b. Students know how to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.	4
1c. Students know electric currents produce magnetic fields and know how to build a simple electromagnet.	3
1d. Students know the role of electromagnets in the construction of electric motors, electric generators, and simple devices, such as doorbells and earphones.	3
1e. Students know electrically charged objects attract or repel each other.	2
1f . Students know that magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.	2
1g. Students know electrical energy can be converted to heat, light, and motion.	4

P A

Standards	# Items
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:	3 items
6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.	✓
6b. Measure and estimate the weight, length, or volume of objects.	
6c. Formulate and justify predictions based on cause-and-effect relationships.	
6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.	
6e. Construct and interpret graphs from measurements.	
6f. Follow a set of written instructions for a scientific investigation.	
Total Items	**25**

Sample Items

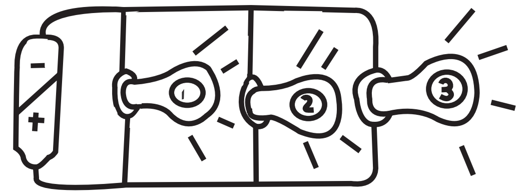
Electricity

The purpose of these sample items is to serve as a tool to assist classroom teachers in assessing student knowledge of specific science content aligned with the *Science Framework for California Public Schools: Kindergarten Through Grade Twelve*. This content can be assessed through a variety of assessment tools.

Multiple Choice

These examples are designed to assess students' knowledge of Grade 4 standard 1a. "Students know how to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs." The examples show a range of difficulty and can be used to give students practice in responding to rigorous multiple choice questions.

1. There are three bulbs in a parallel circuit. Bulb number 3 goes out. What happens to the other bulbs?
A



A. They remain lit
B. They go out
C. They flash on and off
D. They spin

2. A short circuit is very dangerous because _____**C**

A. the length of the circuit is important.
B. it increases resistance.
C. low resistance can create heat.
D. the circuit works too hard.

Question #1 requires students to have a basic familiarity with parallel circuits. To answer this question, students must understand the energy flow across the circuit and that electrical energy flows separately to each bulb.

Question #2 requires students to understand what a short circuit is. In order to answer the question students must understand that a circuit that does not build resistance can create heat. This heat can lead to a wire too hot to touch, or one that starts a fire.

My notes

If these items were on a *Periodic Assessment*, teachers would receive a *Sample Answer Sheet Rationale* that is aligned with these questions. The following shows how these questions would be represented on the *Sample Answer Sheet Rationale*.

Sample Answer Sheet Rationale

Question Number on Live Test	Content Standard	Correct Answer Choice	Description of Distracters
1	1a	A	(a) This answer is correct. (b) Bulbs would go out if this was a series circuit. (c) Bulbs would flash if the electricity was turned on and off through an intermittent signal, like holiday lights. (d) The bulbs would not spin.
2	1a	C	(a) The length of the circuit does not make the short more dangerous. (b) An increased resistance does not result in a short circuit. (c) This is the correct answer (d) A working circuit is not inherently dangerous.

Open Response

The district Periodic Assessments may include open response items.

In the classroom, teachers have a variety of assessment tools to choose from in order to best capture students' understanding of the content. Below are sample open response items that could be used instead of or in combination with multiple choice items to assess students' knowledge of the same content standard (1a).

Open response questions are challenging for students. Teachers may want to scaffold the implementation of these tools depending on the needs of students. Teachers may begin by working with students to develop concept maps to depict the ideas that should be included in an appropriate answer. Students can then use the graphic organizer to develop their response. In time, students will be able to develop these graphic organizers in cooperative groups and independently.

Teachers using open response items should develop rubrics to assist in the scoring of student work. The *LAUSD Generic Scoring Guide for Written Product: Science* (see Appendix, page 42) may be helpful in the development of these rubrics.

> *Question 3:* A student is given a battery, wire, and 2 light bulbs. The student wants build a circuit that will keep the bulbs lit, even if one burns out. What type of circuit should the student build? Why do you think so? Draw the circuit the student should build and label its parts.

The students' response should include the following:

- The student should build a parallel circuit. Since energy flows separately to each bulb, the loss of one bulb will not affect the other bulb (as it would in a series circuit).
- The student should draw a picture of a parallel circuit and label the parts of the diagram (the battery, wires, and bulbs.)

My notes

Question 4: Draw a diagram of a parallel circuit that includes 2 light bulbs and a switch, with the switch controlling both bulbs. Label the circuit's parts. Explain what makes this different from a series circuit. Explain why the location of the switch in your diagram is important.

The students' response should include the following:

- The students' *diagram* should include the following:
  - Series circuit: at least one battery, two bulbs and a correctly positioned switch (labeled)
  - Parallel circuit: lines symbolizing wires (labeled) showing more than one path for electricity between the bulbs and battery
- *The students' response should include the following:*
  - A series circuit loops one wire to connect all the components so current flows sequentially, while a parallel circuit has multiple connections.
  - The switch must control both bulbs, so it must be placed before the first bulb.
  - In a series circuit, if one bulb goes out, all others will go out.
  - In a parallel circuit, if one bulb goes out the other circuit (and its bulb) will still work.

Sample Items

Investigation and Experimentation (I&E)

Multiple Choice

The following examples are designed to assess students' knowledge of standard 6c. "Formulate and justify predictions based on cause-and-effect relationships." The examples show a range of difficulty and can be used to give students practice in responding to rigorous multiple choice questions.

5. When brushing your hair, a few strands stick straight up. Based on this observation, you can predict that __ **D**

   A. it is raining.
   B. your brush is broken.
   C. your hair and brush form an electromagnet.
   D. the hair and brush are electrically "charged".

6. A family put a string of holiday lights on their house that were on every night. One night they came home and the lights were not on. The power to the string of lights was working. Which of the following is the *most* logical reason for the lights to be unlit? **B**

   A. A bulb in the parallel circuit went out.
   B. A bulb in the series circuit went out.
   C. The bulbs were too cold to work.
   D. The battery was not working.

Question #5 requires that students understand that the description is of the effect of static electricity on hair. Based on this observation, the student can select the most appropriate prediction from the choices provided.

Question #6 asks students to apply what they know about series and parallel circuits to a situation. In order for students to predict the reason why the lights are not working they need to understand that the string of lights must be a series circuit for all the lights to have gone out.

If these items were on a Periodic Assessment, teachers would receive a *Sample Answer Sheet Rationale* that is aligned with these questions. The following shows how these questions would be represented on the *Sample Answer Sheet Rationale*.

MY notes

Sample Answer Sheet Rationale

Question Number on Live Test	Content Standard	Correct Answer Choice	Description of Distracters
5	6c	D	(a) Rain does not cause ones hair to stick up. (b) A broken brush will not cause ones hair to stick up. (c) An electromagnet is formed by a magnet with an electrical source. (d) This answer is correct.
6	6c	B	(a) If the string were a parallel circuit, only one bulb would have gone out. (b) This is the correct answer. (c) The bulbs would continue to work even if the temperature was low. (d) Holiday lights usually use the house's electricity rather than a battery, and the stem states that the power to the lights was working.

Open Response

In the classroom, teachers have a variety of assessment tools to choose from in order to best capture students' understanding of the content. Below are sample open response items that could be used instead of or in combination with multiple choice items to assess students' knowledge of the same content standard (6c) as well as provide a context from the discipline standards.

Question 7: Your teacher gives each student in the class some wire, a battery, a nail and a compass. She challenges you to build the strongest electromagnet you can. What factors do you think will be most important in building the strongest electromagnet? How would you test your prediction in order to determine if you are correct?

The students' response should include the following:

- Factors that influence the strength of the electromagnet include the number of wraps of wire around the nail and how tightly these wraps are made.
- The students could test their prediction by building their electromagnet with increasing numbers of wire wraps and testing how much of a metal (like paper clips) it can attract.
- The student could test their prediction by building an electromagnet with loose and tight wraps of wire to determine which attracts more of a metal (like paper clips).

Question 8: A family put a string of holiday lights on their house that were on every night. One night they came home and the lights were not on. First they checked the power to the lights to make sure electricity was flowing into the string of lights. What do you predict is the cause of the lights going out? What would you tell the family to do next to test your prediction?

The students' response should include the following:

- The student might predict that if power is running through the wire, either a wire has become loose or a bulb has burned out. Based on these predictions, the student would tell the family to check the wire connections or test the bulbs to make sure they are not broken.
- The student can infer (I&E grade 4) that this string of lights is a series circuit because if it were a parallel circuit, only one light would be out with the others still lit.

P A

Electricity Unit

MY notes

Introduction

The *Electricity* unit is focused on students' ability to design and build simple electrical circuits and experiment with components such as wires, batteries, and bulbs. Students will observe electrically charged objects that may either attract or repel one another and examine how electrical energy can be converted into heat, light and motion.

Students will examine the attraction and repulsion in static electricity, providing a foundation for Grade 8 when students learn about sub-atomic particles (electrons, neutrons and protons) and the reason this attraction / repulsion occurs. Through a more systematic study of electricity, students explore the difference between series and parallel circuits, and how these structures relate to circuitry they encounter in their everyday lives.

Across Los Angeles there are many resources to support an enriched study of electricity. The city's science museums provide quality exhibits, and a number of local agencies provide opportunities for students to see how the principles they are learning help the city to run efficiently. For a list of district-approved field trips and assemblies, review LAUSD publication GC-148, pg. 35-67. This publication also includes necessary LAUSD bulletins on transportation, safety, and other issues related to field trip excursions.

California Academic Content Standards – This unit focuses on content standards 1a, 1e, and 1g, with significant support for building science process skills in the I&E standards 6a, 6c, 6d and 6f.

California Academic Content Standards:

1a. *Students know* how to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.

1e. *Students know* electrically charged objects attract or repel each other.

1g. *Students know* electrical energy can be converted to heat, light, and motion.

6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

6f. Follow a set of written instructions for a scientific investigation.

Vocabulary – The core vocabulary for the *Electricity* unit focuses on the parts of a circuit and how these components create energy. Additional vocabulary reflects terminology students may have been introduced to in Grades 1-3 and terms that they will become familiar with as a result of rock and mineral identification activities. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons – The additional lesson for this unit is: *Series and Parallel Circuits*.

Critical Questions

- What is static electricity?
- What are different ways to design and build a circuit?
- Why are insulated wires used for our experiments?

My notes

Connections

The following are optional connections that can be made across the curriculum. Specific standards citations for these connections can be found in the publisher's materials.

Language Arts: Students learn a number of vocabulary terms in this unit. As a part of this study, students find that in science, terms may have different meanings than they have in common language (e.g. *switch, attract, repel*).

History - Social Science: Students may become interested in the history of the development of electricity as a technology that has changed not only California, but the world. There are a number of current events regarding the need for inexpensive electricity to maintain our lifestyles and the cultural experience students have grown up with in California.

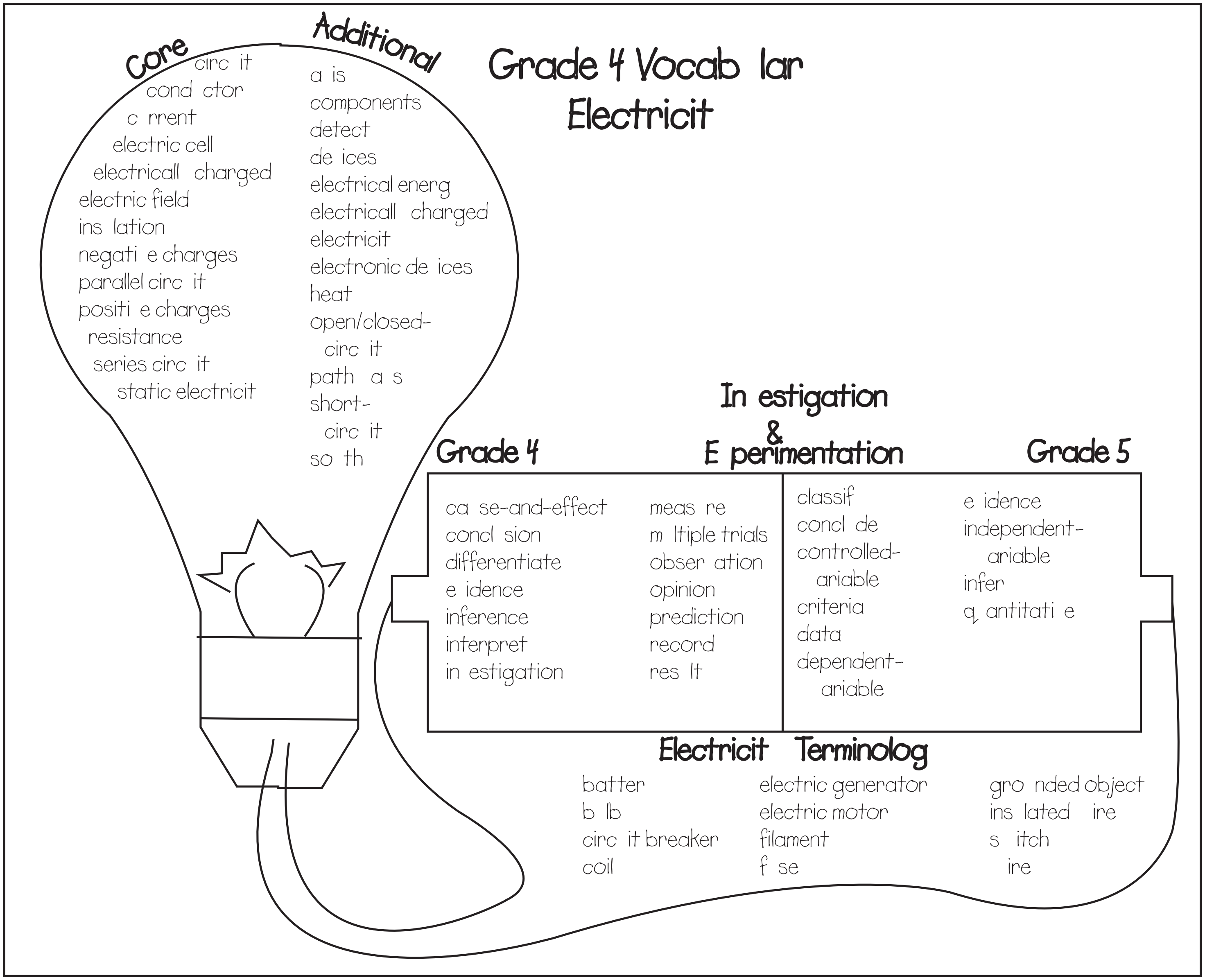
Visual and Performing Arts: Students may be interested in developing their schematic drawings and relating these to blueprints used by architects and electricians, theatrical lighting designers and others. Often these prints are put on display to record how magical effects are created in film, television and stage.

Background

The following information is intended to assist with areas where alternative conceptions of the science content can occur.

- Students enjoy exploring circuits, and this unit can be extended due to their curiosity and interest. For this reason, maintaining a clear focus on the content in the standards and making judicious use of time is of importance.
- Materials to build circuits can be checked out from the District Math / Science / Technology Centers. In addition, wire can be acquired by donation through sources such as CalMaxx (see *Appendix-Web Resources*, page 55) or businesses in your local area. Schools might work with local businesses and parents for donations of batteries to support this work.

"The joy of discovery is certainly the liveliest that the mind can ever feel."
- Claude Bernard (1813-78) French physiologist


Grade 4 Vocab lar
Electricit
Core
circ it
cond ctor
c rrent
electric cell
electricall charged
electric field
ins lation
negati e charges
parallel circ it
positi e charges
resistance
series circ it
static electricit
Additional
a is
components
detect
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electricall charged
electricit
electronic de ices
heat
open/closed-
circ it
path a s
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Grade 4
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concl sion
differentiate
e idence
inference
interpret
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prediction
record
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Grade 5
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ire

California Academic Content Standards:

1a. *Students know* how to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.
1e. *Students know* electrically charged objects attract or repel each other.
1g. *Students know* electrical energy can be converted to heat, light, and motion.
6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
6c. Formulate and justify predictions based on cause-and-effect relationships.
6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
6f. Follow a set of written instructions for a scientific investigation.

HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL * Resources are organized by topic	
RESOURCE	**NOTES**	**RESOURCES**	**NOTES**
Chapter 2 • WB 131; *Transparency* C2 • Lesson 1, *What Is Static Electricity?* pg. C32-37 • Investigation Challenge, p. C35 • WB 132-133 • WB 134–135 • Lesson 2, *What Is an Electric Current*? pg. C38-43 • Investigation Challenge, p. C41 • WB 136-138	• A graphic organizer to use at the beginning of each lesson • De-emphasize conductors and insulators	**Building Simple Circuits** STC Electric Circuits • Lesson 2, *What Can Magnets Do?* Pg. 3-4 FOSS Magnetism and Electricity: Investigation 2, *Making Connections* • *Lighting a Bulb,* Part 1 AIMS Electrical Connections • *Sparky's Light Kit* pg 29-30 **Series vs. Parallel Circuits:** STC Electric Circuits • Lesson 11, *Exploring Series and Parallel Circuits,* pg. 63-67	• Watch out for short-circuiting. This will lead to standard 1g.

P

Published Resources

MY NOTES	HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL * Resources are organized by topic		MY NOTES
	RESOURCE	**NOTES**	**RESOURCES**	**NOTES**	
	Other Resources • Activities for Home or School: *Parallel and Series Circuits*, p. C61 • Activities for Home or School: *Electrical Heat and Light,* p. C61	• Provides a diagram of electrical schematics • Take necessary safety precautions	FOSS Magnetism and Electricity: Investigation 3, *Advanced Connections* • *Building Series Circuits,* part 1 • *Building Parallel Circuits,* part 2 AIMS Electrical Connections • *Pathfinders* pg. 31-34 • *Electric Circuits* pg. 53-55 **Static Electricity** AIMS Electrical Connections • *Static Strokes*, pg. 6-8 • *Different Strokes*, pg. 9-12 **Short Circuits** AIMS Electrical Connections • *Circuit Breakers*, pg. 51-52	• Focus on the attraction and repulsion of charged objects as a gain or loss of electric charger	

If using the *Harcourt Science* program, the lessons listed below provide the needed support for student access to the identified content standards for this unit. Listed resources are provided within this *Guide*.

MY NOTES	RESOURCES IN THIS *GUIDE*	NOTES
	• *Series and Parallel Circuits,* pg. 21	• A series of activities exploring the difference between series and parallel circuits, the purpose of switches and circuit breakers

Standards Alignment

Source	Description	Pages	PS 1b	PS 1c	PS 1d	PS 1f	PS 1g	6a	6c	6d	6e	6f	Notes
			Standards Supported in this Unit										
AIMS: Electrical Connections	Electromagnet Connection	61-62		▼					▼			▼	An investigation on electromagnets .
	Making a Galvanometer	63-64		▼								▼	An investigation in which students build an electromagnet that reverses magnetic poles.
	Electromagnets	70-80		▼	▼						▼	▼	A series of investigations in which students build an electromagnet. Aligned with 6f if focused on different variables to control for.
FOSS: Magnetism and Electricity,	Investigation 4 - Current Attraction: *Building an Electromagnet*	Part 1: 8-13		▼	▼					▼			An activity in which students build an electromagnet.
Harcourt: Chapter 2, Lesson 4	Chapter Concepts	WB131		▼	▼								A Graphic Organizer to introduce each unit in the Earth Science Module.
	How Magnets and Electricity Can Interact	C50-51	▼	▼									An activity in which students begin to explore how magnets and electricity interact.
	Investigate Log	WB 144-145	▼	▼									To be used with *How Magnets and Electricity Can Interact* (pg C50-51) .
	Electromagnets	C52-55	▼	▼	▼		▼						Text
	Investigation Challenge: *Make an Electromagnet*	C54		▼									Use simple materials to design and build an electromagnet.
	Motors and Generators	C56-57			▼		▼						Text
	Science Through Time: *Discovering Electromagnetism*	C58-59			▼								Text on the discovery of electromagnetism and its application in transportation and technology today.

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Standards Alignment

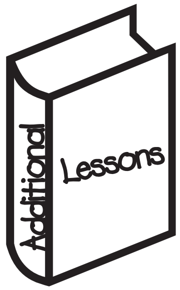
Source	Description	Pages	Standards Supported in this Unit								Notes
			PS 1a	PS 1e	PS 1g	6a	6c	6d	6e	6f	
Harcourt: Chapter 2, Lesson 1	Balloons Rubbed with Different Materials	C32-33		▼		▼		▼		▼	An activity in which students explore static electricity.
	Investigate Log	WB 132 - 133		▼		▼		▼		▼	To be used with activity on static electricity (pg. C32-33); 6d is aligned only if performing the *Investigate Further* section.
	Static Electricity	C34-37		▼							Text
	Investigation Challenge: *Modeling the Movement of Charges*	C35		▼							Modeling the movement of charges due to static electricity.
	Process Skills Practice: *Inference*	WB 134		▼		▼	▼				
	Lesson Concept Review: *Static Electricity*	WB 135		▼							A review of the concepts behind static electricity.
	Module Graphic Organizer: *Electricity and Magnetism*	Trans C2; WB 131	▼	▼							Use this transparency at the beginning of each lesson for electricity, magnetism and electromagnetism.
Harcourt, Chapter 2, Lesson 2	Making a Bulb Light Up	C38-39	▼		▼	▼		▼		▼	An activity in which students learn to make a bulb light using wires, batteries and bulbs.
	Investigate Log	WB136 - 137	▼		▼	▼		▼		▼	To be used with activity on lighting a bulb (pg. C38-39).
	Electric Currents	C40	▼		▼						Text
	Investigation Challenge: *Observing Parts of a Circuit*	C41	▼			▼	▼				An extension of *Making a Bulb Light Up*.
	Series and Parallel Circuits	C42-43	▼								Text

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Standards Alignment

Source	Description	Pages	Standards Supported in this Unit								Notes
			PS 1a	PS 1e	PS 1g	6a	6c	6d	6e	6f	
	Process Skills Practice: *Plan an Investigation*	WB138	▼					▼			Design multiple trials to test different batteries.
	Activities for Home or School: *Electrical Heat and Light*	C61			▼	▼	▼				Take safety precautions. This activity allows students to create an uninsulated circuit to feel electricity converted to heat.
	Activities for Home or School: *Parallel and Series Circuits*	C61	▼							▼	View electrical schematic of parallel and series circuit. Use these diagrams to build each circuit.
Additional Lesson in this Guide to support the Harcourt Program	Series and Parallel Circuits	*Guide*, page 21	▼		▼			▼	▼	▼	This investigation focuses on the distinction between a series and parallel circuit. Students explore how electricity flows through each circuit design, how to interrupt the circuit using a circuit breaker, and the role of insulation to protect from heat.
STC: Electric Circuits	Lesson 2: *What Electricity Can Do*	11-17	▼			▼	▼	▼			An investigation in which students light a bulb.
	Lesson 11: Exploring Series and Parallel Circuits	63-67	▼		▼	▼	▼	▼			Students investigate different types of circuits.

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.



This sample instructional activity illustrates possible strategies for accessing the content within the standards.

Series and Parallel Circuits

Science Standards

1a. Students know how to design and build simple series and parallel circuits by using components such as wires, batteries, and bulbs.

1g. Students know electrical energy can be converted to heat, light, and motion.

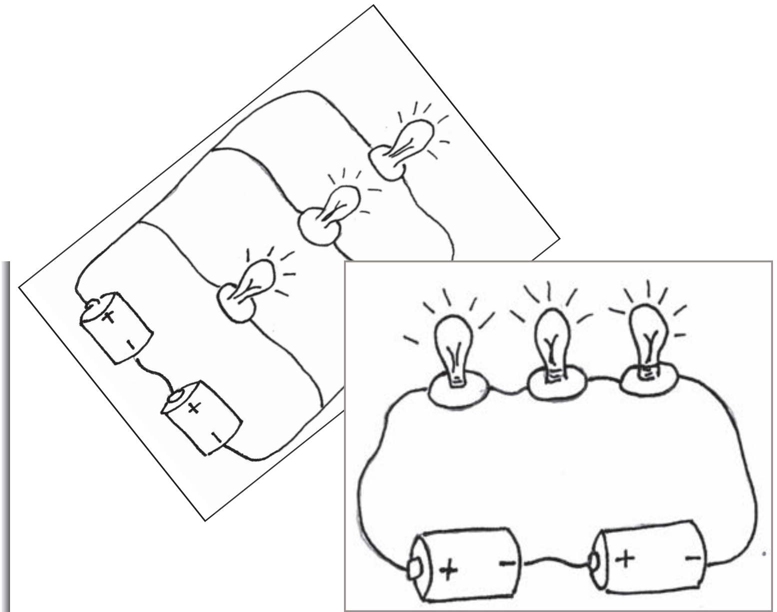
6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

6e. Construct and interpret graphs from measurements.

6f. Follow a set of written instructions for a scientific investigation.

Focus Concepts

- The two basic types of circuits are series circuits and parallel circuits
- Electrical energy can be converted to heat and light through resistance in wires.
- Wires are insulated to protect from heat generated by electrical energy or to keep the electric current traveling in the desired direction.
- Students know the difference between a prediction, a result, and a conclusion.
- Students can use measurements to construct a graph.



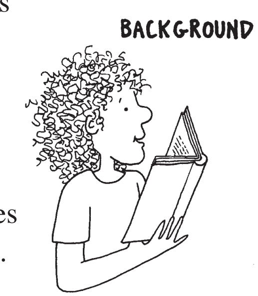
- Students can follow a set of written instructions to perform a scientific investigation.

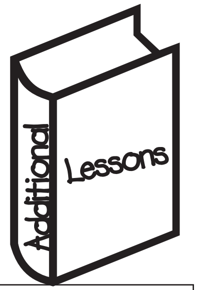
Purpose

To demonstrate the difference between series and parallel circuits.

Background

The *Harcourt Science* activity, *Making a Bulb Light Up,* on pages C38-39 provides students with an inquiry experience with building a variety of simple circuits. On page C40, an image of a series circuit is provided, although not named as such. On page C42, images of parallel and series circuits are provided with an explanation of each. Students may need additional experience with series and parallel circuits in order to master the standard.





This sample instructional activity illustrates possible strategies for accessing the content within the standards.

In a series circuit, electricity has only one path to travel through the batteries, wire and bulbs. When batteries are arranged in a series, the voltage across the bulb is increased, resulting in a brighter bulb (although the batteries drain more quickly). In a parallel circuit, electricity travels along more than one path. The brightness of the bulb will be the same as it would be with one battery, but the batteries will last longer.

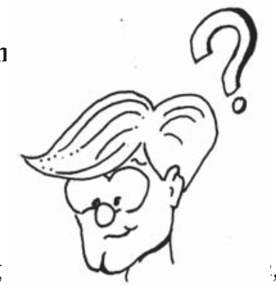
Students also need to understand that the energy from the battery is converted into heat and light when the circuit is connected. The wires are covered in an insulating plastic to keep them from getting hot. Circuit breakers can be used to prevent overheating by being the *weak link* in a circuit. Circuit breakers are a safety measure used to prevent electrical fires.

Part 1

What is the difference between a series and parallel circuit? (time to teach: 60 minutes)

You will need: (for each tean

2 D-cell batteries
Insulated electrical wire
3 miniature light bulbs
Light bulb holders



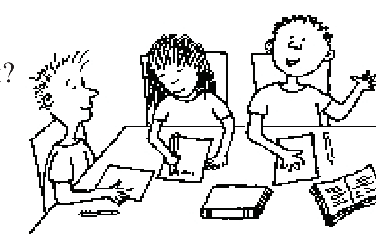
Procedures

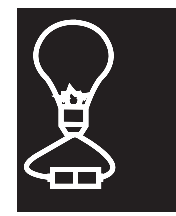
Before beginning ,
students should read about circuits (*Harcourt* pages C38-42).

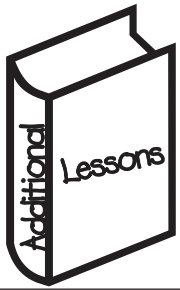
1. To review from the *Harcourt* activity, ask students to chart different ways that they can turn on a light bulb using wire, batteries and a miniature light bulb. Students should recall more than one way to build a closed circuit based on their prior experience.
2. Tell students that they will be given 3 light bulbs, wire and 2 batteries. They will be given two challenges:
   a. Build a closed circuit in which all bulbs light. When one light is removed, the other two go out. (a series circuit)
   b. Build a closed circuit in which all bulbs light. When one is removed, the other two stay lit. (a parallel circuit)
3. Have students diagram predictions for each challenge.
4. Give students the materials and let them follow their procedures to determine at least one way to solve each challenge.
5. Once students have identified solutions, have them diagram them, compare these diagrams with their predictions and share their results with the class. Sort the solutions by similarities and differences. Use this sorting activity to conclude what characterizes a circuit as *series* or *parallel*. Students can write their understanding of these concepts for future reference.
6. Examine the students' diagrams in comparison with an electrician's schematic. Discuss similarities and differences. Discuss why electricians have a formalized set of symbols for their diagrams. (How is this like other diagrams with symbols that you are familiar with?)

Discussion Starters

- What is the difference between a series and a parallel circuit?
- In which kind of circuit did the bulbs glow more brightly? Why?
- How is your diagram like an electrician's schematic? Why do electricians use a formalized schematic to record their work?



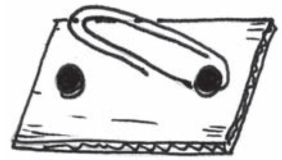




This sample instructional activity illustrates possible strategies for accessing the content within the standards.

Part 2

Making A Switch (time to teach: 20 minutes)



You Will Need: (per team)

Same materials as Part 1
Paperclip
Piece of heavy paper or cardboard
2 metal brads

Procedures

1. When you go into your room, you turn on the lights by turning "on" the light switch. How do you think the switch works?
2. Give the students the materials and have them diagram a design for their *switch*.
3. When ready, have students build their light switch. The switch should be able to turn the light bulbs on and off.
4. Have students share their designs to determine the simplest switch design.
5. Discuss what a switch is for.

Discussion Starters

- When you go into a room and turn on the lights, what do you think the light switch is doing?
- Why are switches used in electrical circuits?

Part 3

Making a Circuit Breaker (time to teach:30 minutes)

You Will Need: (this can be a demonstration or in student teams)

The same materials as Parts 1 and 2
2-3 balloons
Aluminum foil
tape

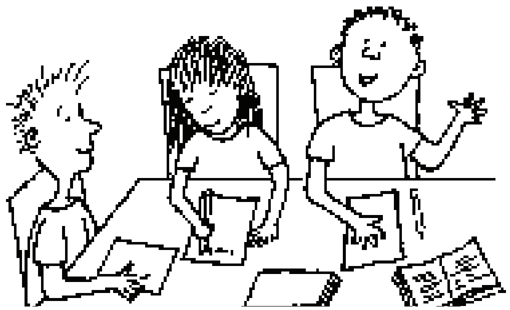
Procedures

1. Ask students why our electrical systems have circuit breakers. How does a circuit breaker keep a circuit from overheating? (it breaks the circuit when too much current is present)
2. Discuss the steps for making circuit breakers. (see student sheets)
3. Have students build the circuit illustrated on the students sheets using only one cell. *The switch should be open when attaching the steel wool.*
4. Have students close the circuit (hopefully the balloon will not pop) and add a cell. If after adding a third cell the balloon still doesn't pop, check for loose connections in the circuit and try again. Students may need to try fewer strands of steel wool.

This sample instructional activity illustrates possible strategies for accessing the content within the standards.

Discussion Starters

- Why does the balloon pop?
- How can you change your circuit breaker so that it is more or less sensitive?
- How does the circuit breaker operate when hooked up with a series of 3 light bulbs in series or parallel?



Sources Used in Developing This Lesson

MS Education Foundation (1991), Electrical Connections*: Circuit Breakers,* pg. 51-52

AIMS Education Foundation (1991), Electrical Connections*: Electric Circuits*, pg. 53 – 55.

FOSS: Magnetism and Electricity, Investigation 3: *Building Parallel Circuits*, part 2, pg. 16 - 19

STC: Electric Circuits, *Exploring Series and Parallel Circuits,* pg. 63-67.

Name:

Series and Parallel Circuits

Part 1

What is the difference between a series and parallel circuit?

You will need: (for each team)

2 D-cell batteries

Insulated electrical wire

3 miniature light bulbs

Light bulb holders

Procedures:

1. Your Challenge:

   Diagram a circuit that would use the materials listed. Design it so that when you remove one bulb the other two go out:

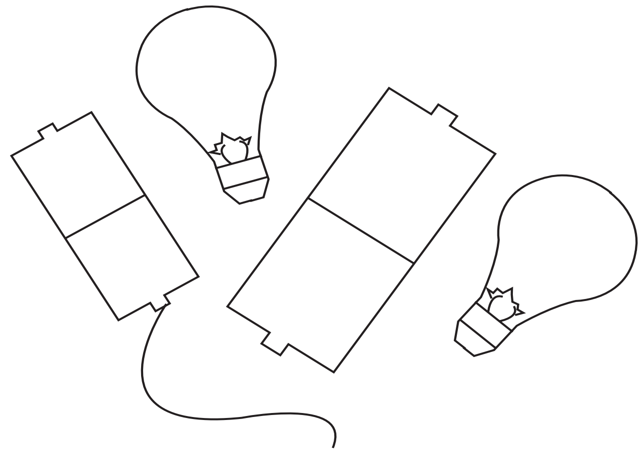


Diagram a circuit that would use the materials listed. Design it so that when you remove one bulb the other two stay lit:

Student Pages

Name:

2. Build your circuits.
3. Diagram your working circuits below. How are they the same or different from the ones you designed?

4. How are the symbols you used in your diagrams like an electrician's *schematic* (a schematic is a picture using symbols)?

Part 2 Making a Switch

You will need: (for each team)

From part 1: 2 D-cell batteries, Insulated electrical wire, 3 miniature light bulbs, Light bulb holders

Paperclip

Piece of heavy paper or cardboard

2 metal brads

Procedures:

1. A switch is a device that allows you to control when the circuit is closed (the light goes on) and when it is open (the light does not go on).

   Design a switch that can be built using a paperclip, heavy paper or cardboard, and metal brads.

Name:

3. Build your circuit and test your switch.
4. Compare your switch with others in your class. Which switch is the simplest to build and use? Why?

____

____

____

____

Part 3 Making a Circuit Breaker

You will need: (for each team)

From part 1: 2 D-cell batteries, insulated wire, 3 light bulbs, light bulb holders

From part 2: your switch

2-3 balloons

Aluminum foil

Steel wool

tape

Student Pages

Procedures:

1. Blow up your balloon (not too full) and tape 3 strands of steel wool to it [figure 1].
2. Tape an aluminum foil strip to each end of the steel wool. [figure 2]
3. Build a circuit using your switch (keep it open while building). [figure 3]
4. Close the circuit breaker. If the balloon did not pop, open the circuit breaker, add another battery (cell) and close the breaker again.

Figure 1:

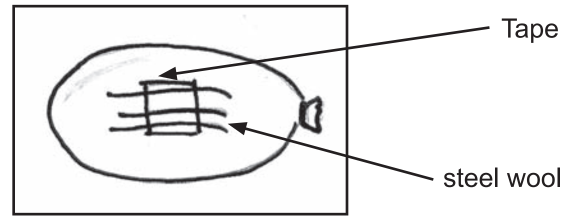


Figure 2:

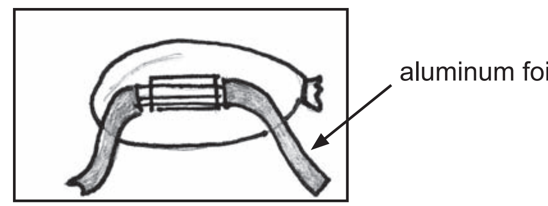
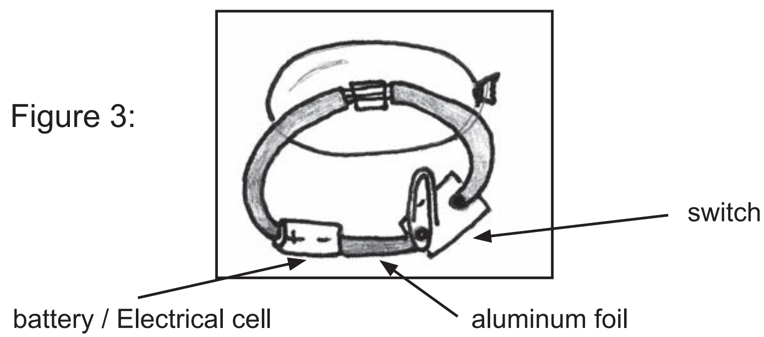


Figure 3:



Name:

Questions:

1. How many battery cells did it take to make the balloon pop?

2. What could the aluminum foil be replaced with to make the system continue working?

3. Why does the balloon pop?

4. How can you change your circuit breaker so that it is more or less sensitive?

5. How does the circuit breaker operate when hooked up with a series of 3 light bulbs in series or parallel?

Student Pages

Magnetism Unit

My notes

Introduction

The *Magnetism* unit is focused on students' ability to understand the principles of magnetism and apply these principles by making devices such as a compass and using this compass to detect magnetic fields, including Earth's magnetic field.

Students will collect evidence of magnetic polarity and understand that scientists can use tools, such as a magnet and compass, to collect evidence about forces they cannot see, such as magnetic fields. This unit, in connection with the *Electricity* unit, provides a foundation for the study of electromagnetism and works with the *Immersion Unit* to provide students with multiple resources to explore this scientific phenomenon.

Across Los Angeles, there are many ways to support an enriched study of magnetism. The city's science museums provide quality exhibits, and a number of local agencies provide opportunities for students to see how the principles they are learning help the city to run efficiently. Teachers may also want to take students into the field to practice their use of compasses. For a list of district-approved field trips and assemblies, review LAUSD publication GC-148, pg. 35-67. This publication also includes necessary LAUSD bulletins on transportation, safety, and other issues related to field trip excursions.

California Academic Content Standards – This unit focuses on content standards 1b and 1f, with significant support for building science process skills in the I&E standards 6a, 6c, 6d, 6e, and 6f.

California Academic Content Standards:

1b. *Students know* how to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.

1f. *Students know* that magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.

6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

6e. Construct and interpret graphs from measurements.

6f. Follow a set of written instructions for a scientific investigation.

Vocabulary –The core vocabulary for the *Magnetism* unit focuses on the effects of a magnet and parts of a compass. Additional vocabulary reflects terminology students may have been introduced to in Grades 1-3 and terms that they will become familiar with as a result of classroom activities. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons – The additional lesson for this unit is: *Build and Use a Compass*.

Critical Questions

- What is a compass?
- How is a compass used to detect Earth's magnetic field?
- What is magnetism and how can it be detected?

My notes

Connections

The following are optional connections that can be made across the curriculum. Specific standards citations for these connections can be found in the publisher's materials.

Language Arts: Students learn a number of vocabulary terms in this unit. As a part of this study, students find that in science, terms may have different meanings than they have in common language (e.g. *attract, repel*).

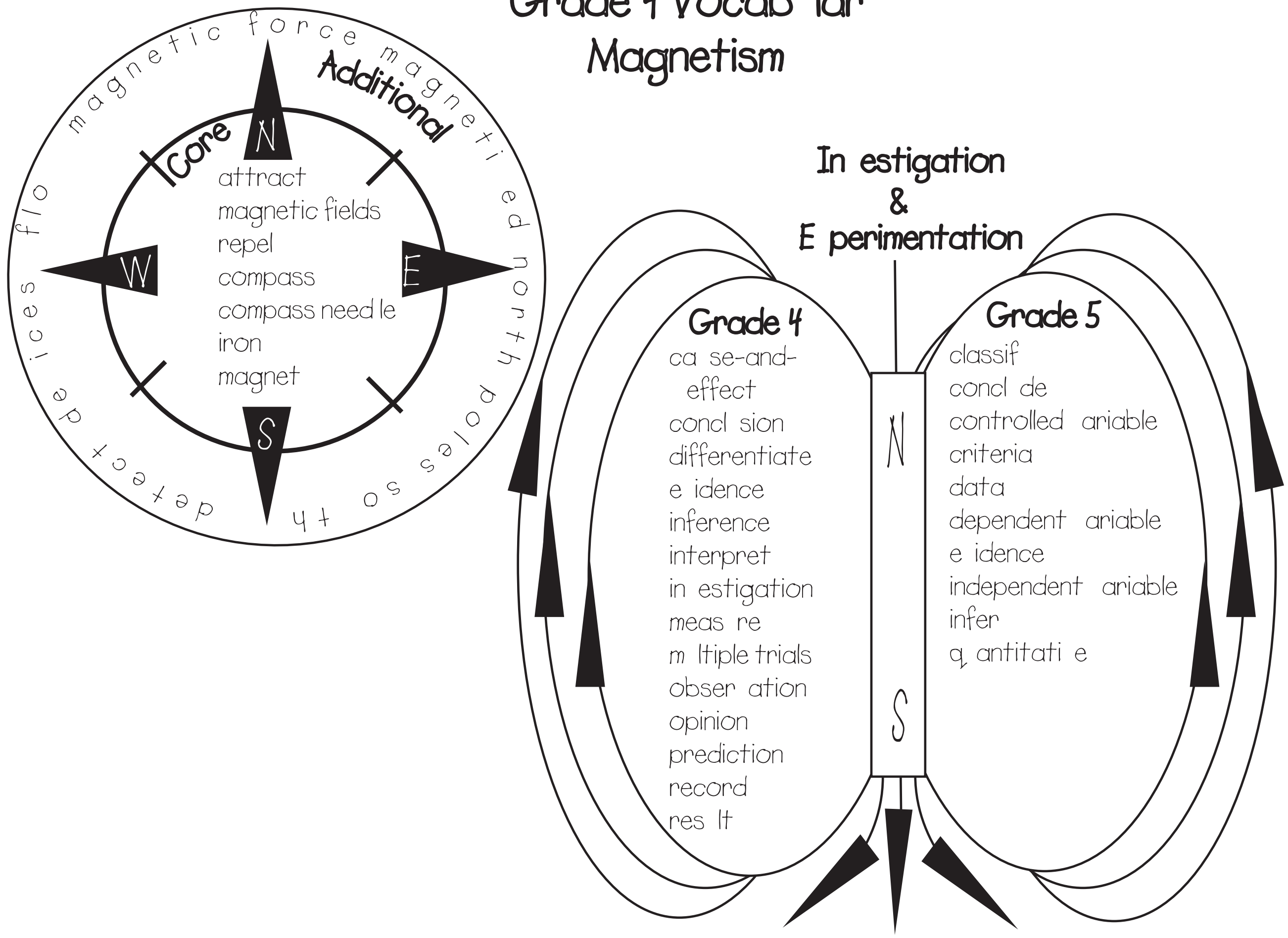
History - Social Science: The development and use of a compass impacted exploration worldwide. Students may be interested in the development of the compass and the different technologies that grew from this invention. In addition, students can heighten their skills locating specific geographic areas and reinforcing the distinction between major geographic locations on Earth including: North and South poles, the equator, and hemispheres by using coordinates to plot locations.

Mathematics: By building and using a compass, students reinforce their understanding the relationship between angles, degrees of a circle, and fractions. They define different triangle shapes based on the paths they create, and practice determining exact and approximate solutions to geometric problems with specified degrees of accuracy.

"Theories are nets cast to catch what we call "the world": to rationalize, to explain, and to master it. We endeavor to make the mesh ever finer and finer."

- Sir Karl Popper, The Logic of Scientific Discovery (1959)

Grade 4 Vocab lar
Magnetism



P
b l i s h e d R e s o u r c e s

California Academic Content Standards:

1b. *Students know* how to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.
1f. *Students know* that magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.
6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
6c. Formulate and justify predictions based on cause-and-effect relationships.
6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
6e. Construct and interpret graphs from measurements.
6f. Follow a set of written instructions for a scientific investigation.

MY notes	HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL * Resources are organized by topic		MY notes
	RESOURCE	NOTES	RESOURCES	NOTES	
	Chapter 2 • WB 131, *Transparency* C2 • Lesson 3, *What Is a Magnet?* pg. C44 - 49 • Investigation Challenge, p. C47 • • WB 140-141 • WB 143 • WB 146	• Begin with graphic organizer • Pay attention to the illustration on the bottom of C48 – compass needles are north / south seeking • Exploration on the strength of magnets	FOSS: Electricity and Magnetism, Investigation 1, *The Force* • *Investigating Magnets and Materials,* Part 1, pg. 8-17 • *Investigating More Magnetic Properties,* Part 2, pg. 18 – 22 • *Breaking The Force*, Part 3, pg. 23-29 • *Science Story,* Make a Compass, p. 31 • Science Extension, *Make a Compass*, p. 36 STC Magnets and Motors • Lesson 5, *Building a Compass,* pg. 11-16 • Lesson 6, *Using a Compass*, pg. 17-20	Supplemental activities listed focus on supporting I&E standards	

If using the *Harcourt Science* program, the lessons listed below provide the needed support for student access to the identified content standards for this unit. These resources are provided within this *Guide*.

MY NOTES	RESOURCES IN THIS *GUIDE*	NOTES
	• Build and Use a Compass, pg. 35	• An alternative compass using easy to find materials with strategies for students to practice using a compass to detect magnetic fields and to chart a course.

Standards Alignment

Source	Description	Pages	Standards Supported in this Unit: PS 1b	PS 1f	6a	6c	6d	6e	6f	Notes
FOSS: Magnetism and Electricity Investigation 1, *The Force*	Part 1: *Investigating Magnets and Materials*	8-17		▼	▼	▼	▼			An investigation in which students observe magnets.
	Part 2: *Investigating More Magnetic Properties*	18-22		▼	▼			▼		An investigation in which students observe temporary magnets.
	Part 3: *Breaking the Force*	23-29			▼		▼	▼		An activity in which students predict, measure and graph the strength of magnetic attraction between magnets.
	Science Extension: *Make a Compass*	36	▼						▼	Students can build a compass. Aligned to 6f if students follow directions independently.
	Science Story: Make a Compass	31	▼							The students will read about Earth's magnetic field.
Harcourt, Chapter 2, Lesson 3	A Compass	C44-45	▼		▼		▼		▼	An activity in which students build a compass. If you replace the cork with Styrofoam, you will not need to use glue. Focuses on prediction and results.
	Investigate Log: *A Compass*	WB140-141	▼		▼		▼		▼	To be used with compass activity (pg. C44-45). Aligned to 6d and 6f if doing the "Investigate Further" section.
	Magnets	C46-47	▼	▼						Text
	Lesson Concept Review: *What is a Magnet?*	WB 143	▼						▼	Section (a) number 3 only.
	Investigation Challenge: Observing the Properties of Magnets	C47		▼	▼	▼	▼		▼	Students explore the strength and polarity of magnets.
	Compasses	C48-49	▼							Text. Examine the illustration at the bottom of the page carefully. Compasses do not point north or south but are north/south seeking.
	Chapter Concepts Graphic Organizer: *Magnetism and Electricity*	WB131; Transparence C2	▼							Graphic organizer to facilitate thinking across the Earth Science module.

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Standards Alignment

Source	Description	Pages	Standards Supported in this Unit							Notes
			PS 1b	PS 1f	6a	6c	6d	6e	6f	
	Process Skills Practice: *Predict*	WB 146					▼			The relationship between predictions and results.
Additional Lesson in this Guide to Support the Harcourt Program	Build and Use a Compass	*Guide*, page 35	▼	▼	▼	▼		▼		Build a compass using easy to find materials. Use the compass to detect magnetic fields and graph simple courses on paper and outside.
STC: Magnets and Motors,	Lesson 5: *Building a Compass*	SB 11-16	▼	▼					▼	An activity in which students build a compass. Aligned to 6f if students follow instructions independently.
	Lesson 6: *Using a Compass: Which Way is Which?*	17-20	▼		▼	▼	▼		▼	Use the compass built in lesson 5 to do this investigation.

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Build and Use a Compass

This sample instructional activity illustrates possible strategies for accessing the content within the standards.

Science Standards

1b. Students know how to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.

1f . Students know that magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.

6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6e. Construct and interpret graphs from measurements.

Math Standards

Measurement and Geometry

3.5 Know the definitions of a right angle, an acute angle, and an obtuse angle. Understand that 90^o, 180^o, 270^o and 360^o are associated, respectively, with 1/4, 1/2, 3/4, and full turns.

3.7 Know the definitions of different triangles (e.g. equilateral, isosceles, scalene) and identify their attributes.

Mathematical Reasoning

2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

History-Social Science Standards

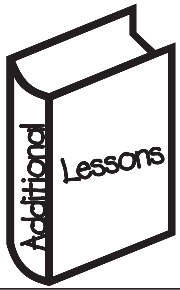
Students demonstrate an understanding of the physical and human geographic features that define places and regions in California.

4.1.2 Distinguish between the North and South Poles; the equator and the prime meridian; the tropics; and the hemispheres, using coordinates to plot locations.

Language Arts Standards

Vocabulary and Concept Development

1.2 Apply knowledge of word origins, derivations, synonyms, antonyms, and idioms to determine the meaning of words and phrases.



This sample instructional activity illustrates possible strategies for accessing the content within the standards.

Focus Concepts

- A compass can be made from simple materials and a magnet.
- A compass can be used to detect magnetic fields.
- The Earth has a magnetic field.
- Magnets have two poles, and they may be called North and South, or positive and negative (+, -).
- Like poles repel and unlike poles attract.
- Explanations come from observations and the interpretation of observations.
- Students will be able to perform multiple experimental trials.
- Students know the difference between a prediction, a result, and a conclusion.
- Students can use measurements to construct a graph.
- Students can interpret graphs.

Purpose

Students will build an easy compass and use it to follow directional paths and create paths for others to follow.

Background

The *Harcourt Science* activity, *A Compass,* on pages C44-45 provides students with an opportunity to build a compass. This compass requires glue which results in materials that cannot be reused later. Once the compass is made, there are no extensions for students to explore how a compass works or what it is used for. The text on pages C46 – C49 provides basic information on magnets and compasses, and that compasses are made with magnets. This information is helpful as students explore how to use a compass to explore Earth's magnetic field.

Part 1

Building the Compass (time to teach: 45 minutes)

You will need: (for each team)

100x15mm plastic petri dish*
a sewing needle, craft or tapestry needle (blunt tip) or a piece of a paper clip will work
a tiny piece of Styrofoam
protractor
magnet
scissors
paper and pencil

*(can be purchased from the District MST Centers – a package of 20 for $2)

Procedures

1. A Petri dish comes in two halves – using the paper, students trace a circle using the bottom half of their Petri dish (the smaller diameter, deeper half).
2. Students use their protractor to make an indicator disk (compass rose) as shown (figure 1) *hint – don't let students cut out the circle until after they draw their angles, since most protractors are too large to fit within the compass rose.*
3. Have students cut out the circle (compass rose) they have drawn and labeled with the protractor, and it will fit neatly into the top of the Petri dish (the larger diameter, shallower half).

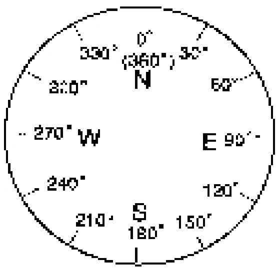
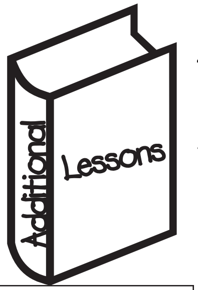


Figure 1



This sample instructional activity illustrates possible strategies for accessing the content within the standards.

4. With the indicator disk facing up, place the bottom of the dish into the top, with both facing up.
5. Fill the bottom half with water. *Hint – students that use pencil to draw their compass rose will not have their writing smudge if the water sloshes over from the bottom of the dish into the top, which it will.*
6. Magnetize the needle by pressing one end of the permanent magnet against the center of the needle (or pin/paper clip) and gently stroke the magnet four or five times toward the point. (see figure 2)
7. Insert the needle through one or two small pieces of Styrofoam and float the needle on the water in the Petri dish. (figure 3)

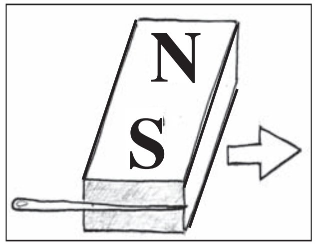


Figure 2

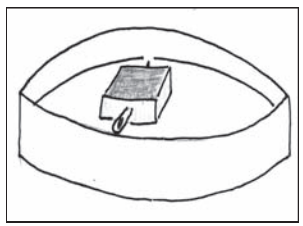
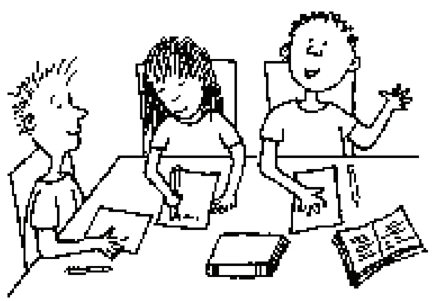


Figure 3

Discussion Starters

- What are the components of a compass?
- How is a compass like / different from a magnet?



Part 2 **Using your compass (time to teach: 20 minutes)**

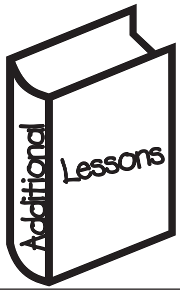
You Will Need: (per team)

Your compass

A magnet

Procedures

1. Ask students which end of their compass they think is the north-seeking end and which end is the south–seeking end.
2. Ask students to develop a test using their magnet and compass to determine if they are right.
3. As students bring the magnet close to the compass, have them describe what they see happening and how this observation helps them to confirm or deny their prediction.
4. Have students examine each other's compasses. Are they all pointing the same way? Why might some of them be pointing in different directions? What can be done about these irregularities? Let them try out their predictions.
5. Vocabulary reinforcement: Give students the *Vocabulary Development Graphic Organizer* and have them define *magnetism*, list the characteristics based on their experiences, list examples and non-examples. Students can share their work and discuss the terminology.



This sample instructional activity illustrates possible strategies for accessing the content within the standards.

Discussion Starters

- Why does the compass needle swing when the magnet is close to it?
- Why does the compass needle react differently to each end of the magnet?
- All magnets have 2 poles, so which end of your compass needle is N and which is S?

Part 3

Solving problems with your compass (time to teach: 30 minutes)

You Will Need:

your compass
a ruler
Lost at Sea student sheet

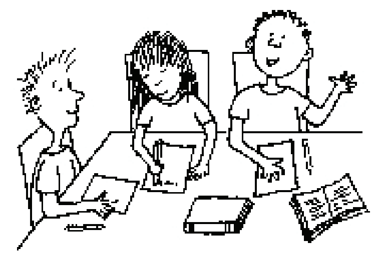
Procedures

1. Tell students that ship captains and crew use a compass to help them navigate when they cannot see the land, such as in the fog or at night. When they know these conditions might exist, they create a list of directions, or headings, to tell them where to go so that they don't run aground or get lost.
2. Give students a copy of the *Lost At Sea* sheet. Explain that this is a map going through a channel with islands (a fiord). The ship has to get to the fuel and get home without hitting the land (grey areas). To prepare for the trip, the captain has asked the students to write directions for their journey.
3. Using the compass, the student will begin at the "start" and identify the heading that the ship will travel in. Using a ruler, the student will identify the distance that the ship will travel in that direction. When it is time to turn, the student will give the new heading and distance, etc. until the end of the journey ("x" marks the end).

Extensions: Students can make their own landscapes with barriers and write out directions for paths through the landscape. If the student only has the directions (without the landscape) and draws the path on clean paper, the landscape can be put underneath it, shine light through the two papers (put them against a window) and see if the path was safe or if the "ship" ran aground. (see *Getting Around Orienteering* student page)

Outside Extension: students can create directions for paths that take on geometric shapes. One team of students can write directions for paths, another set of students can complete paths using sidewalk chalk to mark their work. For doing paths outside, you might want to use meter sticks or walking paces for distance rather than rulers. See *Paths for Group Investigations* for some suggested paths.

Discussion Starters



- What are some reasons for variation in your answers?
- How can you make your compass more accurate?
- How does knowing the location of the Earth's magnetic field help you?

Sources Used in Developing This Lesson

HMSS, Fluid Earth Curriculum

Lawrence Hall of Science, Equals Investigations: *Telling Someone Where to Go*

Vocabulary Development

Definition (in own words)

Characteristics

Magnetism

Examples (from own life)

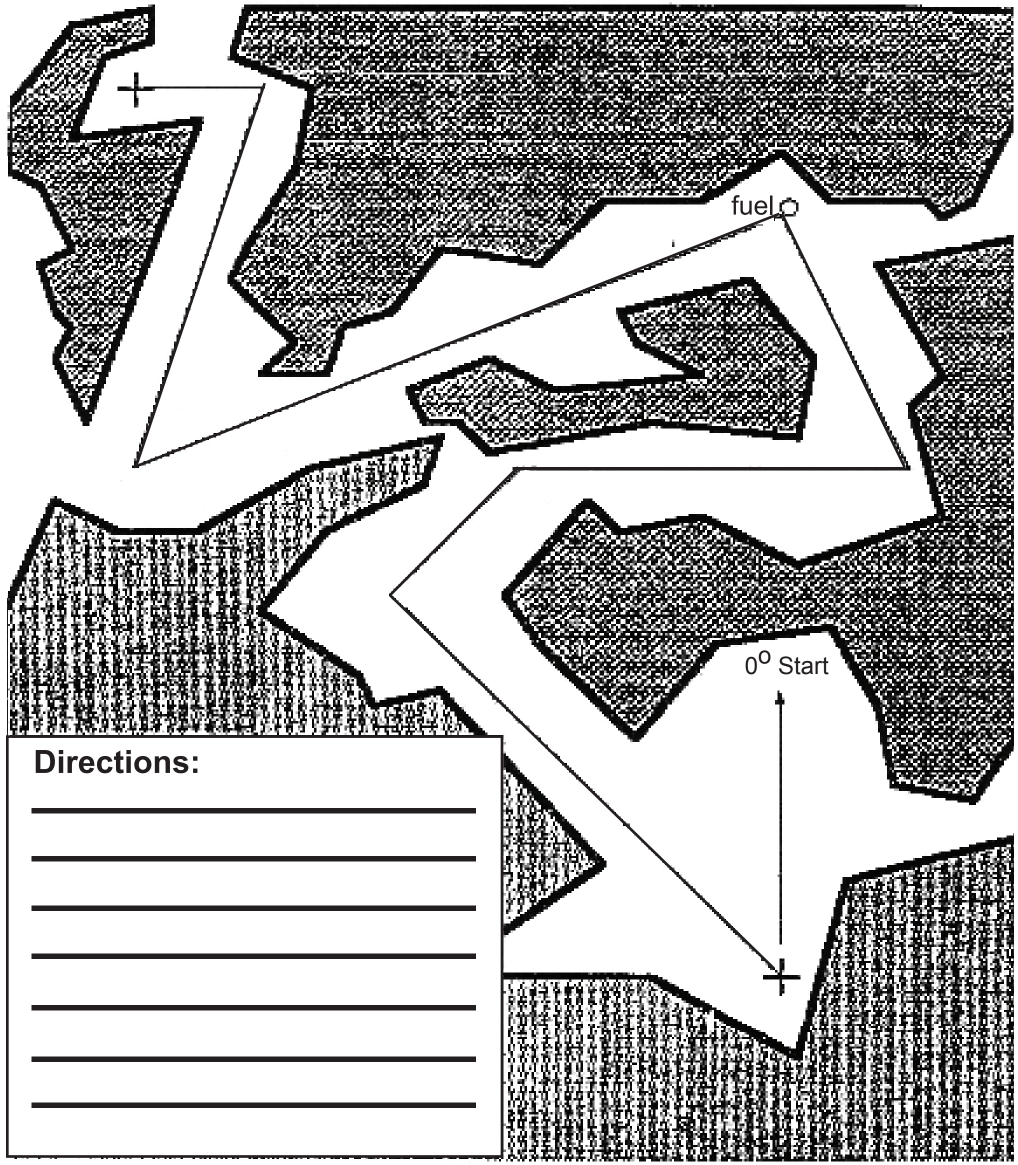
Something not magnetic (from own life)

*From "A Schema for Testing the Level of Concept Mastery," by D.A. Frayer, W.C. Frederick, and H.G. Klausmeier.

Name:

Lost at Sea

You are the captain of this ship that is lost at sea. It is dark and foggy, but you have this map that is already marked. Make the measurements so that your ship can get fuel and sail home.



Directions:

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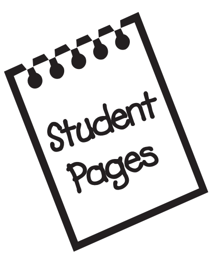


Name:

Getting Around

Create a course using your compass or protractor.

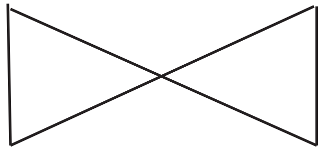
Team member 1: Lay out directions for your course on the left side of the page. Give your course to team member 2.

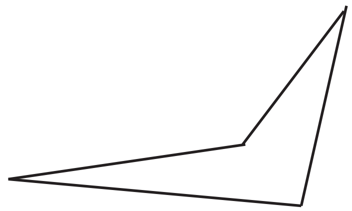
Team member 2: Follow the course directions using your compass or protractor (as specified). Draw the course in the box on the right. Be sure to label the headings for each turn and distances for each leg of the course. Return this paper to team member 1 when finished so that your solution can be checked.

Team Member 1	Team Member 2
Path name: Protractor / compass (circle one) Orienteering Path Directions:	

Paths for Investigations

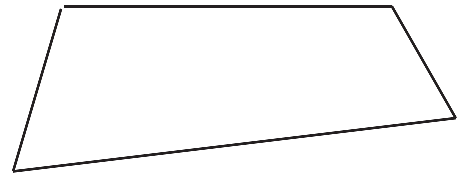
Bow tie-shaped paths

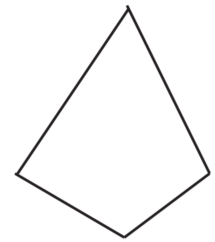




Boomerang-shaped paths
(closed paths with four legs , shaped like a boomerang)

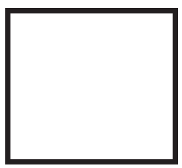
Closed, four-leg paths with no legs equal

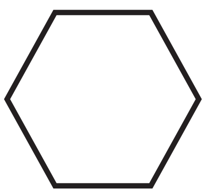


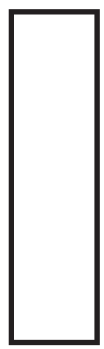


Kite-shaped paths
(closed paths with four legs having two pairs of adjoining legs equal)

Paths with legs of equal lengths

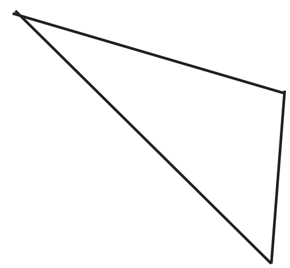


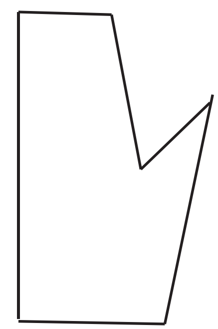




Rectangualr-shaped paths

Triangular paths
(closed paths with three legs)





Closed paths with five or more legs

Electricity and Magnetism Unit

My notes

Introduction

The *Electricity and Magnetism* unit focuses on the interaction between electricity and magnetism, known as electromagnetism. Students learn how to build a simple electromagnet and how they are used in simple devices.

Across Los Angeles, there are many ways to support an enriched study of electromagnetism. The city's science museums provide quality exhibits, and a number of local agencies provide students with opportunities to see how the principles they are learning help the city run. For a list of district-approved field trips and assemblies, review LAUSD publication GC-148, pg. 35-67. This publication also includes LAUSD bulletins on transportation, safety, and other issues related to excursions.

California Academic Content Standards – This unit focuses on content standards 1b – 1d and 1g, with significant support for building science process skills in the I&E standards 6c - 6f.

California Academic Content Standards:

1b. *Students know* how to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.

1c. *Students know* electric currents produce magnetic fields and know how to build a simple electromagnet.

1d. *Students know* the role of electromagnets in the construction of electric motors, electric generators, and simple devices, such as doorbells and earphones.

1g. *Students know* electrical energy can be converted to heat, light, and motion.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.

6e. Construct and interpret graphs from measurements.

6f. Follow a set of written instructions for a scientific investigation.

"The purpose of models is not to fit the data but to sharpen the questions." Samuel Karlin, 1983

Vocabulary – The core vocabulary for the *Electricity and Magnetism* unit focuses on the parts of an electromagnet and the interaction between electricity and magnetism. Additional vocabulary reflects terminology students may have been introduced to in Grades 1-3 and terms that they will become familiar with as a result of classroom activities. Key I&E vocabulary for Grades 4 and 5 are provided as a reference.

Additional Lessons – The additional lesson for this unit is *Electromagnetism.*

Critical Questions

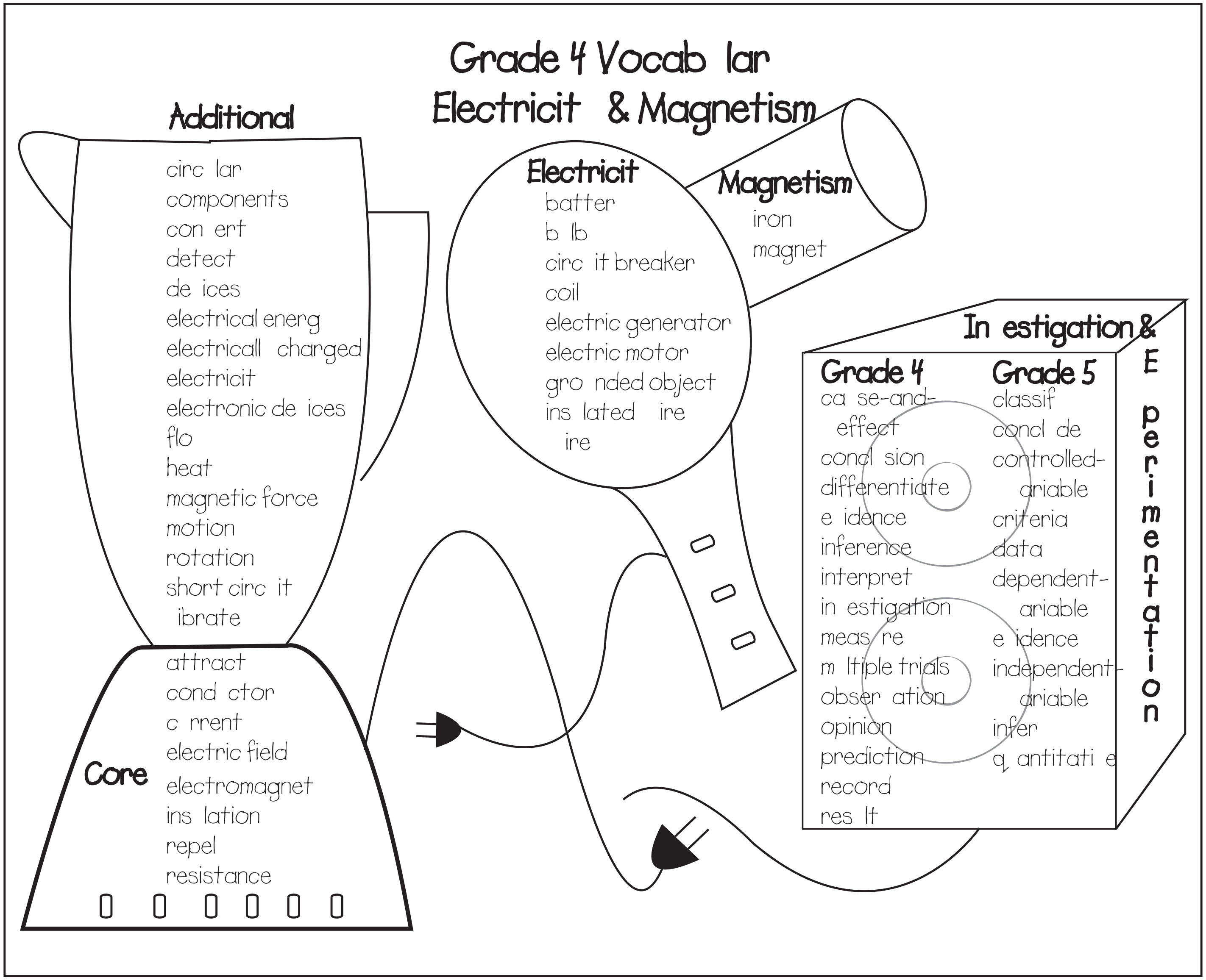
- What is an electromagnet and how can you build one?
- How can you prove that electrical circuits produce magnetic fields?
- What is the role of electromagnets in simple devices and how do they convert electrical energy into heat, light, and motion?

Connections

The following are optional connections that can be made across the curriculum. Specific standards citations for these connections can be found in publisher's materials.

Language Arts: Students find that in science, terms may have different meanings than they have in common language (e.g. grounded, current, resistance).

History - Social Science: Students may be interested in the origination, development, and use of electromagnets, and how they have changed our society. Students can research the role of electromagnets in California's economy and industries.


Grade 4 Vocab lar
Electricit & Magnetism
Additional
circ lar
components
con ert
detect
de ices
electrical energ
electricall charged
electricit
electronic de ices
flo
heat
magnetic force
motion
rotation
short circ it
ibrate
Core
attract
cond ctor
c rrent
electric field
electromagnet
ins lation
repel
resistance
Electricit
batter
b lb
circ it breaker
coil
electric generator
electric motor
gro nded object
ins lated ire
ire
Magnetism
iron
magnet
In estigation & E perimentation
Grade 4
ca se-and-effect
concl sion
differentiate
e idence
inference
interpret
in estigation
meas re
m ltiple trials
obser ation
opinion
prediction
record
res lt
Grade 5
classif
concl de
controlled- ariable
criteria
data
dependent- ariable
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independent- ariable
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California Academic Content Standards:

1b. *Students know* how to build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.
1c. *Students know* electric currents produce magnetic fields and know how to build a simple electromagnet.
1d. *Students know* the role of electromagnets in the construction of electric motors, electric generators, and simple devices, such as doorbells and earphones.
1g. *Students know* electrical energy can be converted to heat, light, and motion.
6c. Formulate and justify predictions based on cause-and-effect relationships.
6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
6e. Construct and interpret graphs from measurements.
6f. Follow a set of written instructions for a scientific investigation.

MY notes	HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL * Resources organized by topic		MY notes
	RESOURCE	**NOTES**	**RESOURCES**	**NOTES**	
	Chapter 2 • WB 131 • Lesson 4, *What Is an Electromagnet?* pg. C50-57 • WB 144-145 • WB 146 • WB 147 • People in Science, p. C60 • Science Through Time pg. C58-59	• Begin with graphic organizer	**Electromagnetism** AIMS, Electrical Connections • *Electromagnets* pg. 70-80 • *Electromagnetic Connection* pg. 61-62 • *Making a Galvanometer* pg. 62-64 FOSS: Electricity and Magnetism, Investigation 4, *Current Attractions Building An Electromagnet*, Part 1	Supplemental activities listed focus on supporting I&E standards	

My notes	HARCOURT SCIENCE TEXTBOOK		SUPPLEMENTAL * Resources organized by topic		My notes
	RESOURCE	**NOTES**	**RESOURCES**	**NOTES**	
			STC Magnets and Motors • Lesson 7, *Creating Magnetism Through Electricity*, pg. 21 – 24 • Lesson 8, *Making Magnets and Electricity,* pg. 25 - 30		

If using the *Harcourt Science* program, the lessons listed below provide the needed support for student access to the identified content standards for this unit. These resources are provided within this *Guide*.

MY NOTES	RESOURCES IN THIS *GUIDE*	NOTES
	• Electromagnetism, pg. 49	• Focus on electromagnets having 2 poles and that these poles can be reversed

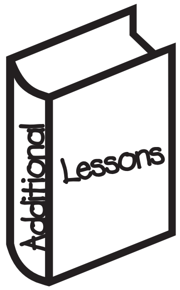
Standards Alignment

Source	Description	Pages	Standards Supported in this Unit										Notes
			PS 1b	PS 1c	PS 1d	PS 1f	PS 1g	6a	6c	6d	6e	6f	
AIMS: Electrical Connections	Electromagnet Connection	61-62		▼					▼			▼	An investigation on electromagnets.
	Making a Galvanometer	63-64		▼								▼	An investigation in which students build an electromagnet that reverses magnetic poles.
	Electromagnets	70-80		▼	▼						▼	▼	A series of investigations in which students build an electromagnet. Aligned with 6f if focused on different variables to control for.
FOSS: Magnetism and Electricity,	Investigation 4 - Current Attraction: *Building an Electromagnet*	Part 1: 8-13		▼	▼					▼			An activity in which students build an electromagnet.
Harcourt: Chapter 2, Lesson 4	Chapter Concepts	WB131		▼	▼								A Graphic Organizer to introduce each unit in the Earth Science Module.
	How Magnets and Electricity Can Interact	C50-51	▼	▼									An activity in which students begin to explore how magnets and electricity interact.
	Investigate Log	WB 144-145	▼	▼									To be used with *How Magnets and Electricity Can Interact* (pg C50-51).
	Electromagnets	C52-55	▼	▼	▼		▼						Text
	Investigation Challenge: *Make an Electromagnet*	C54		▼									Use simple materials to design and build an electromagnet.
	Motors and Generators	C56-57			▼		▼						Text
	Science Through Time: *Discovering Electromagnetism*	C58-59			▼								Text on the discovery of electromagnetism and its application in transportation and technology today.

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.

Source	Description	Pages	Standards Supported in this Unit: PS 1b	PS 1c	PS 1d	PS 1f	PS 1g	6a	6c	6d	6e	6f	Notes
	People in Science: *Raymond V. Damadian*	C60			▼								Text on the development of the MRI, a tool that uses magnets and electricity to create images of the inside of a living organism.
	Process Skills Practice: *Predict*	WB 146											
	Lesson Concept Review: *Electromagnets*	WB147		▼	▼								
Additional Lesson in this Guide to support the Harcourt Program	Electromagnetism	*Guide*, page 49		▼		▼		▼	▼		▼		Students build an electromagnet, identify its magnetic fields and reverses its polarity. Students can also design an experiment to test what factors make an electromagnet stronger or weaker.
STC: Magnets and Motors	Lesson 7: *Creating Magnetism through Electricity*	SB 1-24	▼	▼					▼	▼		▼	Students investigate the relationship between magnets and electricity.
	Lesson 8: *Making Magnets and Electricity*	25-30		▼					▼			▼	An activity in which students build an electromagnet. Aligned with 6f if students follow the directions independently.

Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.



This sample instructional activity illustrates possible strategies for accessing the content within the standards.

Electromagnetism

Science Standards

1c. Students know electric currents produce magnetic fields and know how to build a simple electromagnet.

1f. Students know that magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.

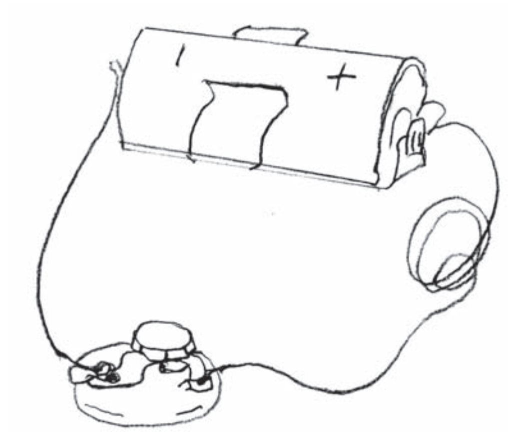
6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

6c. Formulate and justify predictions based on cause-and-effect relationships.

6e. Construct and interpret graphs from measurements.

Focus Concepts

- Wires, an iron core, and a battery can be used to build a simple electromagnet
- Electric currents produce magnetic fields.
- An electromagnet has two poles and these poles can be reversed.
- Like poles repel and unlike poles attract.
- Students can use measurements to construct a diagram.
- Students can interpret their diagrams.
- Explanations come from observations and the interpretation of observations.
- Students can make and justify predictions using cause-and-effect principles.

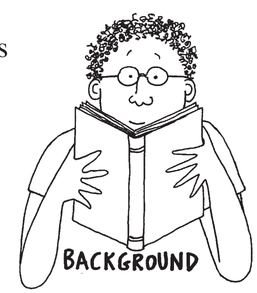


Purpose

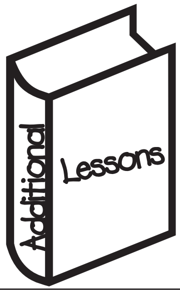
To help students understand electromagnets.

Background

The Harcourt Science text provides a basic background of what an electromagnet is and some simple devices where they can be found. However, students may need additional support to understand the relationship between electricity and magnetism in an electromagnet.



When a current flows through a wire, it creates a magnetic field that surrounds the wire. The polarity of this field depends on the direction of the current in the wire. By coiling the wire, the magnetic field can be strengthened.



This sample instructional activity illustrates possible strategies for accessing the content within the standards.

Part 1 Building an Electromagnet (time to teach: 60 minutes)

You will need: (for each team)

1 D-cell battery (with holder)

Insulated electrical wire

1 miniature light bulb

Light bulb holder

Switch (you can use the one you made in the Electricity Unit)

Magnetic compass (you can use the one you made in the Magnetism Unit)

Procedures

Students have studied circuits using Harcourt Science pages C38-42.

1. To begin this experience, ask students to recall what they remember about building a simple series circuit.
2. Ask students to remember what they learned about the properties of magnets.
3. Discuss how you built a compass and the role of the magnet in that compass. How could students make a magnet? Listen to students' ideas, and if it's not brought up, ask if there might be a way to use electricity to make a magnet.
4. Give students the battery, wire, switch, and bulb. In their groups, have them build a series circuit (the switch is to turn off the circuit when not needed, in order to save the battery).
5. Ask students if they think the circuit has magnetic properties. How could they test? (put the compass next to the circuit).
   a. When students put the compass near the wires of the circuit, they will see that the compass needle is in alignment with the direction of the wires.
   b. Students can test that this phenomenon is the result of electricity by turning on and off the switch and watching the compass.
6. Coil a long wire and secure it so that it does not unwind (figure 1). When the circuit is fully connected, put the compass near the coil (figure 2). What happens? How is the coil acting differently from when the wire was not coiled? Is the coil magnetic?

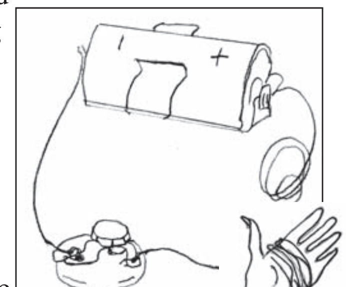


Figure 1

7. Since magnets have two poles, use the compass to determine where the poles of the coil are (the strongest magnetic field). Students can draw the lines of force on the student pages.

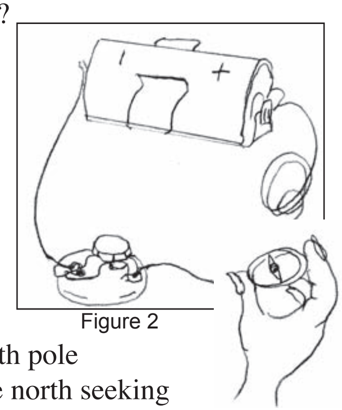
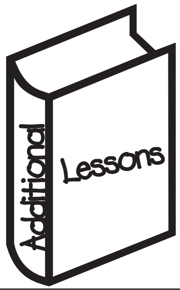


Figure 2

   a. Review that the labeled north pole on a compass is actually the north seeking pole – and is in reality, the south pole of the compass magnet. Students need to remember that the end of their compass needle that points north will be attracted to the north pole of their magnet / electromagnet. Have students label their drawing with the north and south poles of their electromagnet.



This sample instructional activity illustrates possible strategies for accessing the content within the standards.

8. Ask students what they think will happen to the electric current if you take the battery out of the holder and turn it around. Ask students if they think this will affect the polarity of their electromagnet. Have them test this.

Discussion Starters

- What is an electromagnet?
- How can you make a magnet using electricity?
- How can the polarity of your magnet be reversed?

Part 2

Making A Stronger Electromagnet (time to teach: 60 minutes)

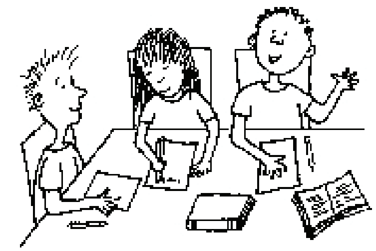
You Will Need: (per team)

Same materials as above
Paper clips
Large iron nail or bolt (8 cm x 6 mm) (If a nail is used, students should be careful with the point)

Procedures

1. Now that students know what a simple electromagnet is, discuss how electromagnets could be used to help people do work (picking up heavy objects, as a motor to make machines move, etc.).
2. Ask students why we would want a strong electromagnet to pick up things (students might relate this to a junk yard where electromagnets are used to pick up cars for disposal).
3. Discuss ways to make the electromagnet built in part 1 stronger or weaker. Using the list of ideas generated, have students decide which idea(s) their team will test. Discuss how each idea is a *variable*, one thing being changed in the original design to determine if it results in a stronger / weaker electromagnet.
4. Have students build a series circuit with a coil as they did in part 1. Based on the idea they are testing, students should make one change to their design at a time to test their idea. On the student pages provided, students should record their process and findings.
5. Discuss each group's findings. If more than one group tests the same idea and gets different data, have them work together to check their experimental processes.
6. Once data is confirmed, have students graph and examine the data to determine what factors result in a stronger / weaker electromagnet (strength could be tested by the amount of paperclips held by the magnet). Can students think of any other way to test the strength of an electromagnet? (increasing the distance between the compass and coil, etc.).

Discussion Starters



- Why is it important to keep clear and accurate notes of your experimental process?
- What factors influence the strength of an electromagnet?

Sources Used in Developing This Lesson

AIMS, Electrical Connections: *The Electromagnetic Connection*, pg. 61-62

AIMS, Electrical Connections: *Make a Galvanometer*, pg. 63-64

STC: *Magnets and Motors,* Lessons 7 – 93.

Name:

Electromagnetism

Part 1 Building an Electromagnet

You will need: (for each team)

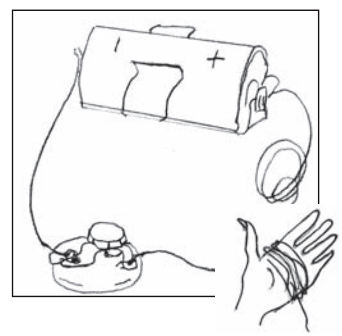
- 1 D-cell battery (with holder)
- Insulated electrical wire
- 1 miniature light bulb
- Light bulb holder
- Switch (you can use the one you made in the *Electricity Unit)*
- Magnetic compass (you can use the one you made in the *Magnetism Unit*)

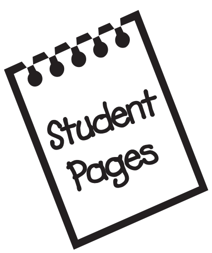
Procedures

1. Build a series circuit and draw the circuit you built below:

2. What happens when you put the compass near the wires of your circuit? (Draw the compass needle near your wire in the diagram above.)

   Use a long piece of wire to coil and secure as part of your series circuit (see figure below).





Name:

***Think and write*:**

a. When the circuit is fully connected, put the compass near the coil. What happens?

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b. How is the coil acting differently from when the wire was not coiled? Is the coil magnetic?

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5. Since all magnets have two poles, use the compass to determine where the poles of the coil are (the strongest magnetic field). Draw the lines of force and label the north (N) and south (S) poles of your electromagnet.

6. What do you think would happen to the electrical current if you turned the battery around? How would this affect the polarity of the electromagnet?

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7. Test your idea. What happened?

____

____

Student Pages

Name:

Part 2 Making A Stronger Electromagnet

How can I make a stronger or weaker electromagnet?

Idea I am testing	Change to my circuit (only change one thing at a time)	Number of paper-clips my electro-magnet will pick up

Graph your results:

What factor(s) influence the strength of an electro-magnet?

Module Planning Calendar

This optional planning tool is provided to assist in personal and shared instructional planning. Space is provided to record the unit of instruction, selected published resources, and possible classroom assessments for each week of the Module. Circle the days of the week for instruction (M, T, W, Th, F) and note the lessons for implementation in the space provided.

Grade: ________________ **Teacher(s):** ______________________ **Trimester:** _________

Week	Unit of Instruction:	Selected Resource(s):	Assessment:
1			
M T W Th F			
2			
M T W Th F			
3			
M T W Th F			
4			
M T W Th F			

Developed based on design by Diana Roston, LAUSD teacher.

Module Planning Calendar

Week	Unit of Instruction:	Selected Resource(s):	Assessment:	Week	Unit of Instruction:	Selected Resource(s):	Assesment:
5				6			
M T W Th F				M T W Th F			
7	Unit of Instruction:	Selected Resource(s):	Assessment:	8	Unit of Instruction:	Selected Resource(s):	Assesment:
M T W Th F				M T W Th F			
9	Review and Periodic Assessment			10	Review and Periodic Assessment		
M T W Th F				M T W Th F			

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