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Elementary Science Instructional Guide

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Grade 5

Instructional Services Division



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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.

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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



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.

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

“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)

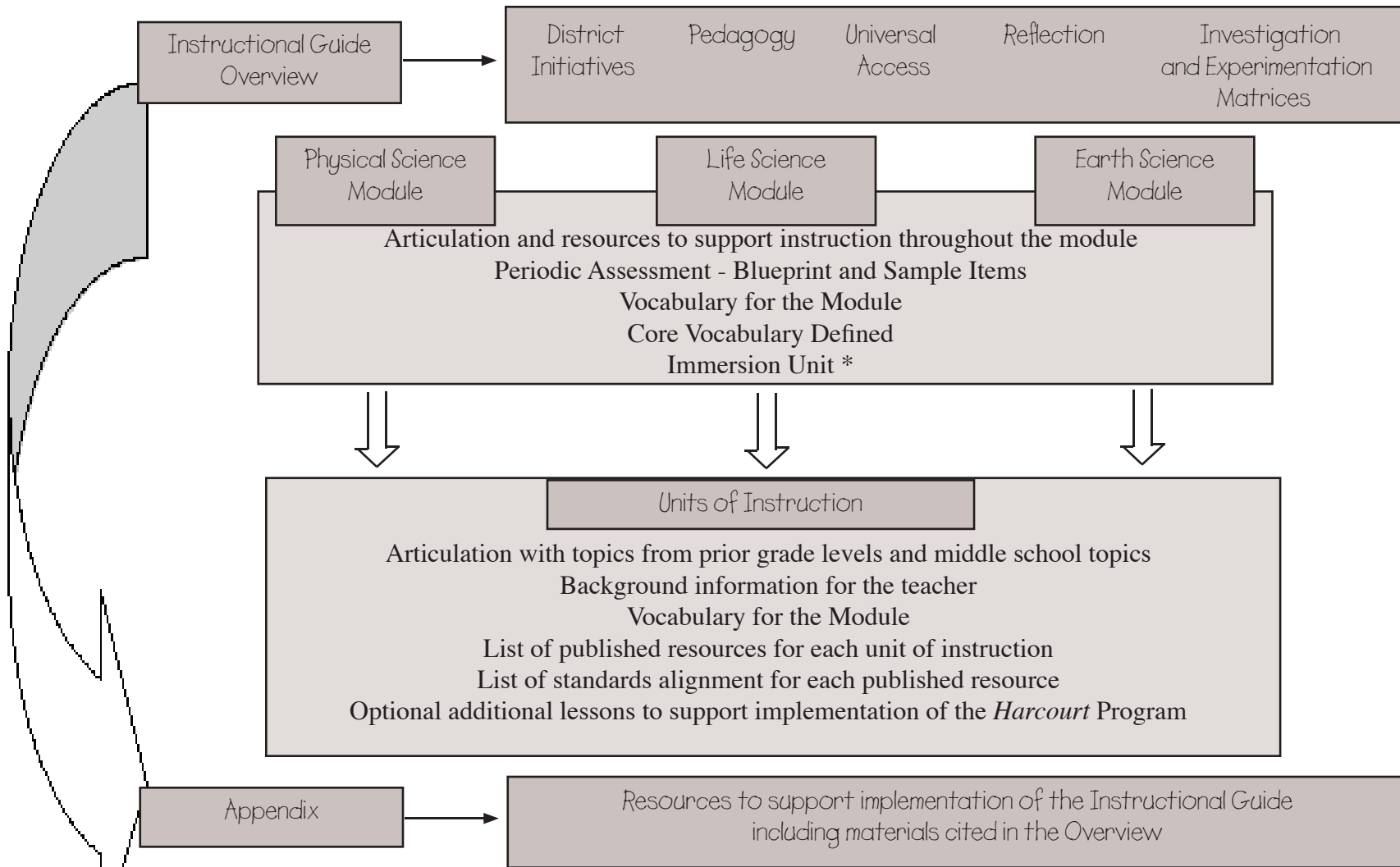


objectives. The NCLB science requirement specifies that by the 2007-08 school year states should give standards-aligned assessments in science at least once in the grade spans 3-5, 6-9, and 10-12. The results of these assessments, as well as those in English, mathematics, and history-social science, 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

Site Map



* 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 Ietier, 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 Nimmualrat, Juliet Ethiryeerasingam; **Local District K:** Kathleen Samms, Keri Porter, Kimberley Vladovick, Loa Caudill, and Glen Isomoto.

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Grade 5 Physical Science

Introduction

In Grade 5 physical science, students are introduced to chemical reactions and the concept that atoms combine to form molecules. This requires that students clearly distinguish between molecules and atoms, chemical compounds, and mixtures. Students are introduced to the idea that the organization of elements in the Periodic Table of the Elements (Periodic Table) is related to similarities and trends in the chemical properties of the elements.

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 begin to describe objects by their physical properties and are introduced to the states of matter using water as the primary example. In Grade 1 this knowledge deepens, adding that substances can change when mixed, cooled, or heated. In Grade 3, students are introduced to the concepts of matter, atoms, and chemical change. Students are also introduced to the Periodic Table as a tool scientists use to organize information about different types of atoms. In Grade 4, students may refer to the Periodic Table when identifying rocks and minerals, should the discussion include the elements that make up specific minerals (e.g. some rocks are attracted to magnetite because of their high iron content).

The content for Grade 5 deepens students' understanding of previously learned material, and prepares them for a deeper study of chemistry in Grade 8 and high school.

This module of the *Instructional Guide* is designed to provide teachers with a variety of resources to support implementation of the Grade 5 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 5 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. Core Vocabulary refers to terminology all students should master as a result of instruction. Additional Vocabulary refers to terms 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 reviewing and refining student understanding of the processes from Grade 4.

Immersion Unit - The Grade 5 physical science Immersion Unit provides students with an opportunity to develop their own experiments to explore the chemical properties of metals. This Immersion Unit includes extensions in which students can explore different facets of the content and share their findings with the rest of the class. This is an excellent opportunity to connect with parents and local businesses that might have expertise in this area as “resident experts” for students to ask them questions.

Units of Instruction – The units of instruction for Grade 5 physical science include: *Atoms, Molecules and the Periodic Table* and *Chemical and Physical Reactions*. 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 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 5 Physical Science Module, both units of instruction 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 items on each of the Grade 4 standards in addition to all but one of the Grade 5 standards (standard 3e). In examining the test blueprint, eleven (11) items on the test will be aligned with the nine Grade 5 physical science standards. Since almost all standards will be tested with at least one question, students should have a



foundational understanding of the content in each of the Grade 5 physical science standards.

- Particular care should be taken to discuss the terms “independent variable,” “dependent variable,” and “controlled variable.” These terms are used in the *California Science Framework*, and specific questions may be asked about these terms on the Grade 5 California Standards Test in science. In the words of the standards, “Scientific progress is made by asking meaningful questions and conducting careful investigations.” In any investigation, there are factors (variables) that you control or accept (controlled or independent variables), and those that are dependent upon the question you are asking (dependent variables). The terms *controlled* and *independent* variables are used interchangeably in many texts all the way through high school, and even in some college texts (although the difference relates to the types of factors studied). Typically, a controlled variable is one that you not only control, you can manipulate. Typically, an independent variable is also one that you control (how often you make your observations), but do not manipulate (for example, you don’t change the number of minutes in an hour). Because you do have control over both of these variables, the terms are used interchangeably at this level by many texts, but there is a subtle distinction.



“I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind.”

Lord Kelvin (William Thomson, 1st Baron) (1824-1907) English physicist and mathematician.

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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 (H₂O), nitrogen (N₂), oxygen (O₂), carbon dioxide (CO₂), methane (CH₄), and propane (C₃H₈).
- 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.

Key Knowledge and Concepts

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).

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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 (C₆H₁₂O₆), water (H₂O), helium (He), oxygen (O₂), nitrogen (N₂), and carbon dioxide (CO₂).

- 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 (C₆H₁₂O₆), water (H₂O), helium (He), oxygen (O₂), nitrogen (N₂), and carbon dioxide (CO₂).
- 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.

| Key Knowledge and Concepts | Grade 5 - Science Content Standards Investigation and Experimentation | Key Knowledge and Concepts from the California Science Framework |
|----------------------------|---|---|
| e | 6a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria. | <ul style="list-style-type: none"> Students classify objects using a set of criteria. |
| y | 6b. Develop a testable question. | <ul style="list-style-type: none"> Students develop a question that can be tested through experimental means. |
| k | 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure. | <ul style="list-style-type: none"> 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. |
| n | 6d. Identify the dependent and controlled variables in an investigation. | <ul style="list-style-type: none"> Students identify the dependent variable in an investigation. Students identify the controlled variable in an investigation. |
| o | 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. | <ul style="list-style-type: none"> 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. |
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| K | Grade 5 - Science Content Standards Investigation and Experimentation | Key Knowledge and Concepts from the California Science Framework |
|--|--|---|
| e y k n o w l e d g e a n d c o n c e p t s | 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • 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 | metallic |
| alloy | microscope |
| array | microscopy |
| atom | mixture |
| base | molecular model |
| chemical properties | molecule |
| chemical reaction | non-metallic |
| classification | particle |
| composite | Periodic Table |
| compound | physical properties |
| dissolve | pressure |
| ductile | product |
| electrical thermal- conductivity | reactants |
| electron | salt |
| element | solid |
| filter | solubility |
| freezing point | solution |
| gas | sublimation |
| liquid | substance |
| malleable | symbol |

Grade 5 Investigation & Experimentation

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

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 (CO₂)
- Methane (CH₄)
- Nitrogen (N₂)
- Oxygen (O)
- Propane (C₃H₈)
- Salt (NaCl)
- Sugar (C₆H₁₂O₆)
- Water (H₂O)

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

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.



Periodic Assessment

As an integral element of the *Elementary Periodic Assessment Program*, the Grade 5 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 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.

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

5 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 Assessment Blueprint

| Standards | # Items |
|---|----------|
| 1. Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept: | 22 items |
| 1a. Students know that during chemical reactions the atoms in the reactants rearrange to form products with different properties. | 2 |
| 1b. Students know all matter is made of atoms, which may combine to form molecules. | 2 |
| 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. | 3 |
| 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. | 3 |
| 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. | 1 |
| 1f. Students know differences in chemical and physical properties of substances are used to separate mixtures and identify compounds. | 4 |



| Standards | # Items |
|--|---------|
| 1g. Students know properties of solid, liquid, and gaseous substances, such as sugar (C ₆ H ₁₂ O ₆), water (H ₂ O), helium (He), oxygen (O ₂), nitrogen (N ₂), and carbon dioxide (CO ₂). | 4 |
| 1h. Students know living organisms and most materials are composed of just a few elements. | 2 |
| 1i. Students know the common properties of salts, such as sodium chloride (NaCl). | 1 |
| 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. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria. | ✓ |
| 6b. Develop a testable question. | |
| 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure. | |
| 6d. Identify the dependent and controlled variables 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. | |
| 6f. Select appropriate tools (e.g., thermometers, metersticks, balances, and graduated cylinders) and make quantitative observations. | |
| 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data. | |

| Standards | # Items |
|--|---------|
| 6h. Draw conclusions from scientific evidence and indicate whether further 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. | |
| Total Items | 25 |



Sample Items

Atoms, Molecules and the Periodic Table

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.

Reference Sheet – Periodic Table of Elements

(use large version provided in the Appendix, page 15, with students)

| | | | | | | | | | | | | | | | | | | |
|-------------------------|--------------------------|--------------------------|--------------------------------|-----------------------------|-----------------------------|---------------------------|--------------------------|-----------------------------|---------------------------|--------------------------|----------------------------|----------------------------|--------------------------|------------------------------|---------------------------|-----------------------------|------------------------|--|
| 1 1 H Hydrogen | | | | | | | | | | | | | | | | | 2 2 He Helium | |
| 3 3 Li Lithium | 4 4 Be Beryllium | | | | | | | | | | | 5 5 B Boron | 6 6 C Carbon | 7 7 N Nitrogen | 8 8 O Oxygen | 9 9 F Fluorine | 10 10 Ne Neon | |
| 11 11 Na Sodium | 12 12 Mg Magnesium | | | | | | | | | | | 13 13 Al Aluminum | 14 14 Si Silicon | 15 15 P Phosphorus | 16 16 S Sulfur | 17 17 Cl Chlorine | 18 18 Ar Argon | |
| 19 19 K Potassium | 20 20 Ca Calcium | 21 21 Sc Scandium | 22 22 Ti Titanium | 23 23 V Vanadium | 24 24 Cr Chromium | 25 25 Mn Manganese | 26 26 Fe Iron | 27 27 Co Cobalt | 28 28 Ni Nickel | 29 29 Cu Copper | 30 30 Zn Zinc | 31 31 Ga Gallium | 32 32 Ge Germanium | 33 33 As Arsenic | 34 34 Se Selenium | 35 35 Br Bromine | 36 36 Kr Krypton | |
| 37 37 Rb Rubidium | 38 38 Sr Strontium | 39 39 Y Yttrium | 40 40 Zr Zirconium | 41 41 Nb Niobium | 42 42 Mo Molybdenum | 43 43 Tc Technetium | 44 44 Ru Ruthenium | 45 45 Rh Rhodium | 46 46 Pd Palladium | 47 47 Ag Silver | 48 48 Cd Cadmium | 49 49 In Indium | 50 50 Sn Tin | 51 51 Sb Antimony | 52 52 Te Tellurium | 53 53 I Iodine | 54 54 Xe Xenon | |
| 55 55 Cs Cesium | 56 56 Ba Barium | 57 57 La Lanthanum | 72 72 Hf Hafnium | 73 73 Ta Tantalum | 74 74 W Tungsten | 75 75 Re Rhenium | 76 76 Os Osmium | 77 77 Ir Iridium | 78 78 Pt Platinum | 79 79 Au Gold | 80 80 Hg Mercury | 81 81 Tl Thallium | 82 82 Pb Lead | 83 83 Bi Bismuth | 84 84 Po Polonium | 85 85 At Astatine | 86 86 Rn Radon | |
| 87 87 Fr Francium | 88 88 Ra Radium | 89 89 Ac Actinium | 104 104 Rf Rutherfordium | 105 105 Db Dubnium | 106 106 Sg Seaborgium | 107 107 Bh Bohrium | 108 108 Hs Hassium | 109 109 Mt Meitnerium | | | | | | | | | | |
| | | | 58 58 Ce Cerium | 59 59 Pr Praseodymium | 60 60 Nd Neodymium | 61 61 Pm Promethium | 62 62 Sm Samarium | 63 63 Eu Europium | 64 64 Gd Gadolinium | 65 65 Tb Terbium | 66 66 Dy Dysprosium | 67 67 Ho Holmium | 68 68 Er Erbium | 69 69 Tm Thulium | 70 70 Yb Ytterbium | 71 71 Lu Lutetium | | |
| | | | 90 90 Th Thorium | 91 91 Pa Protactinium | 92 92 U Uranium | 93 93 Np Neptunium | 94 94 Pu Plutonium | 95 95 Am Americium | 96 96 Cm Curium | 97 97 Bk Berkelium | 98 98 Cf Californium | 99 99 Es Einsteinium | 100 100 Fm Fermium | 101 101 Md Mendelevium | 102 102 No Nobelium | 103 103 Lr Lawrencium | | |



Multiple Choice

These examples are designed to assess students' knowledge of Grade 5 science standard 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." The examples show a range of difficulty and can be used to give students practice in responding to rigorous multiple choice questions.

1. Which of the following is a compound? **C**

- A. Aluminum
- B. Copper
- C. Brass
- D. Oxygen

2. The most important information on the periodic table is the ____? **A**

- A. atomic number.
- B. row each atom is in.
- C. atomic symbol.
- D. name of each element.

Question #1 requires students to know that the Periodic Table provides information on elements and any substance that is not listed on the Table is a combination of more than one element (a compound).

Question #2 requires students to know that the Periodic Table is a graphic organizer to help scientists remember the atomic number of each element as well as specific properties about each element based on its position in the Periodic Table.

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 | 1d | C | (a) Aluminum is a pure element. (b) Copper is a pure element. (c) This answer is correct. (d) Oxygen is a pure element. |
| 2 | 1d | A | (a) This answer is correct. (b) The row does not provide information on properties of elements. (c) The atomic symbol is important for reference, but not the most important information on the Table. (d) Some Periodic Tables do not list the names of the elements, only the symbols. Names are provided as a convenience. |

Open Response

The district Periodic Assessments may include open response items.

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 may want to develop rubrics to assist in the scoring of student work. The *LAUSD Generic Scoring Guide for Written Products: Science* (see Assessment Section of Rationale) may be helpful in the development of these rubrics.

Question 3: Describe the location of the element Carbon on the Periodic Table.

The students' response should include the following:

- The location of the element Carbon on the Periodic Table can be described using a variety of different strategies. Students should use at least one of the following:
 - Row 2, Column 14
 - Atomic number 6
 - Symbol "C"

Question 4: Explain the structure of the Periodic Table.

The students' response should include the following:

- The Periodic Table lists elements in the order of their atomic number from left to right and from the top to the bottom of the table.
- Other common information about each element is its name and symbol. Some Periodic Tables have additional information such as atomic mass.
- Areas on the Periodic Table may be shaded or colored to provide information on elements' metallic or non-metallic structure, state of matter at room temperature, or other properties being studied.

- Elements are grouped in columns (called *families* or *groups*) based on common chemical properties
- There are many Periodic Tables, and the Table has changed over time as scientists learn more about the elements.

Sample Items

Investigation and Experimentation (I&E)

Multiple Choice

These examples are designed to assess students' knowledge of Grade 5 I&E standard 6f. "Select appropriate tools (e.g., thermometers, metersticks, balances, and graduated cylinders) and make quantitative observations." The examples show a range of difficulty and can be used to give students practice in responding to rigorous multiple choice questions.

5. A mixture can be separated using ___ C

- A. an iodine-starch reaction.
- B. an acid-base test.
- C. filter paper.
- D. combustion.

6. Which of the following tools would best be used to determine the volume of an apple? B

- A. a balance
- B. a graduated cylinder
- C. a ruler
- D. a piece of filter paper



Question #5 requires that students have participated in scientific activities. Students need to recognize that to separate a mixture, the appropriate tool must be selected. Other tools such as strainers or sieves could also be used depending on the type of mixture.

Question #6 asks students to select the most appropriate tool to determine the volume of an irregular shaped object. Students should be familiar with the use of a graduated cylinder or other calibrated container to measure the change in water level when an object is submerged.

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 | 6f | C | (a) This will test the presence of starch, but will not separate a mixture. (b) This will test the acidity of a substance, but will not separate it into its components. (c) This answer is correct. (d) This will change the mixture chemically rather than separate it into its original components. |

| Question Number on Live Test | Content Standard | Correct Answer Choice | Description of Distracters |
|------------------------------|------------------|-----------------------|---|
| 6 | 6f | B | (a) A balance would be used to weigh the apple. (b) This choice is correct. (c) A ruler is used to measure the height or width of the apple. (d) Filter paper would not be used to measure an apple. |

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 standard (6d) as well as to provide a context from the discipline.

Question 7: A student wants to test the boiling and freezing points of water and salt water. What tools would the student need to gather in order to perform these tests? What would each tool be used for?

The students' response should include the following:

- To test the boiling point of water and salt water:
 - A hot plate to heat the substances
 - A thermometer to measure the temperature of the substance when it boils
 - A container to put the substance in when on the hot plate



- Safety goggles to wear during the experiment
- A timer if the experiment is asking for how long it takes for each solution to reach boiling
- (optional) a stirring rod to mix the salt water; a measuring device to make constant the amount of salt used in the salt water solution
- To test the freezing point of water and salt water:
 - A container for the water and salt water
 - A freezer to make the solutions cold
 - A thermometer to determine the freezer temperature
 - A timer if the experiment is asking for how long it takes for each solution to reach freezing
 - (optional) a stirring rod to mix the salt water; a measuring device to make constant the amount of salt used in the salt water solution

Question 8: A student has a jar with the following ingredients: sand, marbles, iron filings, and salt. What tools would you use to separate this mixture? How would you measure each of these ingredients?

The students' response should include the following:

- To remove the iron filings, use a magnet.
- To remove the marbles, use a strainer.
- To remove the sand, add water, then use filter paper.
- To remove the salt, let the water and salt solution sit in a warm place until the water evaporates out.
- Each ingredient can be weighed when separated.





Atoms, Molecules & the Periodic Table

The *Atoms, Molecules and the Periodic Table* unit provides students with the opportunity to become more familiar with the Periodic Table and build a foundation in chemistry. Students explore some properties of common elements and differentiate between atoms and molecules, as well as between mixtures and compounds. Students begin to use chemical (atomic) symbols and think about conservation of matter.

As a basis for understanding the Periodic Table, teachers should note that a copy of the Periodic Table will be provided to students when they take the California Standards Test (CST). A copy of this reference sheet is provided in the appendix to this *Guide*. Based on this information, students should be familiar with how to use the Periodic Table to determine the location of elements, and that the most important information on the Periodic Table is the atomic number. Students should know that the Periodic Table is a graphic organizer that has changed over time and continues to change depending on the purpose for its use. Students are not expected to memorize the Periodic Table.

Across Los Angeles there are many resources to support an enriched study of chemistry. The city's museums often provide a wide variety of resources, curriculum, and field trip opportunities that focus on basic chemistry principles. Local agencies and businesses, depending on their focus, may also provide enriching experiences that deepen students' understanding of the content they are learning. 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-e, 1g-i, with significant support for

building science process skills in the I&E standards 6a, 6c, 6g and 6h.

California Academic Content Standards:

- 1a. *Students know* that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
- 1b. *Students know* all matter is made of atoms, which may combine to form molecules.
- 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.
- 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.
- 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.
- 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).
- 1h. *Students know* living organisms and most materials are composed of just a few elements.
- 1i. *Students know* the common properties of salts, such as sodium chloride (NaCl).
- 6a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.

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- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- 6h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.

Vocabulary – The core vocabulary for the *Atoms, Molecules and the Periodic Table* unit focuses on common elements and descriptions of common mixtures and compounds. Additional vocabulary reflects terminology students may have been introduced to in Grades K-3, and terms that they will become familiar with as a result of the activities provided. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons – The additional lesson for this unit is *Periodic Bingo*.

Critical Questions

- How are atoms arranged on the Periodic Table?
- What properties can be used to identify compounds or metals?
- What are some common properties of salts?
- How is there such variety in living organisms when all living organisms are made primarily of just a few elements?

QUESTIONS?



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., *matter, compound*). In addition, students learn the symbols scientists use to represent elements. Students might compare this use of symbols with abbreviations in English. Students might be interested in why some of the symbols do not use the same letters as the name of the element (e.g., iron as Fe, silver as Ag, etc.) and that this relates to the Greek or Latin derivation of the name of the element.

Mathematics: As students learn chemical (atomic) symbols, they will look at some equations such as that for photosynthesis and cellular respiration. Students can note that they balance chemical equations in the same way as mathematical equations.

History-Social Science: Students may be interested in how elements were discovered or created. The school Library Media Teacher can assist with a number of resources in this area. In addition, students may explore where different elements are mined to connect with their understanding of the rich natural resources available in the United States and around the world, and how these resources have resulted in some nations' great wealth.

Background

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

- In Grade 3 students are first introduced to the Periodic Table. At that time students became familiar with the names of some of the elements and the origin of some elements' names. In Grade 5, students increase their knowledge about



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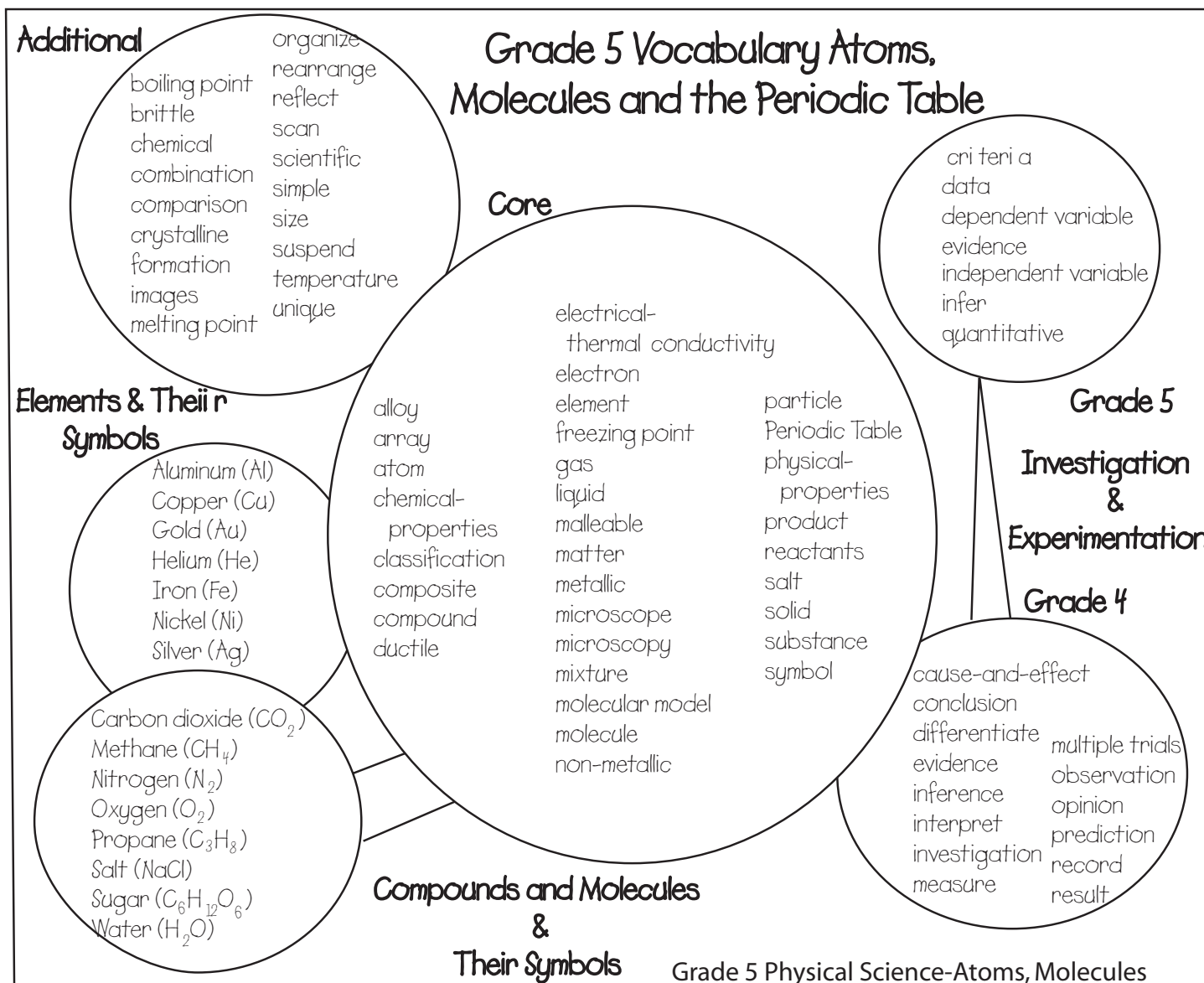
the Periodic Table and how scientists use it as a valuable tool. Students begin to be familiar with the symbolic representation of some common elements and how to use symbols to represent some common molecules. Students are not expected to memorize the Periodic Table.

- The standards and *Framework* asks students to understand that an atom is the smallest particle that maintains the properties of that element. Students do not need to know subatomic particles and bonding properties of atoms until Grade 8 (standards 7a - c).
- There is one image of a scanning tunneling microscope on page C53 in the *Harcourt Science* text, and this is the only reference in the text to standard 1e. Teachers may require supplemental resources to provide students with additional information on this standard.

*“Within our bodies
course the same
elements that flame
in the stars.”*



*- Susan
Schiefelbein,
The Incredible
Machine
(1986)*






California Academic Content Standards:

- 1a. *Students know* that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
- 1b. *Students know* all matter is made of atoms, which may combine to form molecules.
- 1c. *Students know* metals have properties in common, such as high electrical and thermal conductivity. Some metals, such as Al 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.
- 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.
- 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.
- 1g. *Students know* properties of solid, liquid, and gaseous substances, such as sugar (C₆H₁₂O₆), water (H₂O), helium (He), oxygen (O₂), nitrogen (N₂), and carbon dioxide (CO₂).
- 1h. *Students know* living organisms and most materials are composed of just a few elements.
- 1i. *Students know* the common properties of salts, such as sodium chloride (NaCl).
- 6a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- 6h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.

|  | HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | |  |
|---|---|--|---|-------|---|
| | RESOURCE | NOTES | RESOURCES | NOTES | |
| | Chapter 2 <ul style="list-style-type: none"> Lesson 1, <i>What Are Atoms and Elements?</i>, pg. C38 – 45 Lesson 2, <i>What Are Compounds?</i> pg. C46 - 51 WB 150-151 WB 153 | <ul style="list-style-type: none"> Subatomic particles, speed of reactions and density are to be mastered in Grade 8 History of the Periodic Table is interesting, but beyond the standard | Elements and Molecules Evan-Moor Corp, <i>Read and Understand Science: Grades 4-6</i> (EMC 3305) <ul style="list-style-type: none"> Probing the Periodic Table, pg. 90-94 FOSS: <i>Mixtures and Solutions, Investigation 1, Science Stories</i> <ul style="list-style-type: none"> <i>Mixtures and Solutions</i>, pg. 1-6 <i>Earth Elements</i>, pg. 11-12 | | |

Grade 5 Physical Science - Atoms, Molecules
and the Periodic Table Published Resources



| HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | |
|---|---|--|--|
| RESOURCE | NOTES | RESOURCES | NOTES |
|  <p>Chapter 2</p> <ul style="list-style-type: none"> • Science Through Time, pg. C52-53 • People In Science, <i>Glenn T. Seaborg</i>, p. C54 Activities for Home or School • <i>Periodic Table</i>, p. C55 • <i>Rusty Wool</i>, p. C56 • <i>Splitting Water</i>, p. C57 • Science Through Time <i>Developing Sources of Energy</i>, pg. C90-91 | <ul style="list-style-type: none"> • Pay close attention to the information in the timeline. | <p>FOSS: Mixtures and Solutions, Investigation 4, <u>Science Stories</u></p> <ul style="list-style-type: none"> • <i>What is Matter Made Of?</i>, pg. 25 – 27 • <i>The Periodic Table</i>, pg. 32 – 36 <p style="text-align: center;">Compounds and Mixtures</p> <p>Evan-Moor Corp, <i>Read and Understand Science: Grades 4-6</i> (EMC 3305)</p> <ul style="list-style-type: none"> • A Compound Mystery, pg. 65 – 69 <p>FOSS: Mixtures and Solutions, Investigation 1</p> <ul style="list-style-type: none"> • <u>Science Stories: How Do Atoms Rearrange?</u> p. 2 <p>Investigation 3, <u>Science Stories</u></p> <ul style="list-style-type: none"> • <i>The Air You Breathe</i>, pg. 20-22 <p>Investigation 4, <u>Science Stories</u></p> <ul style="list-style-type: none"> • <i>The Metals</i>, pg. 37 - 42 • <i>The History of Rubber</i>, pg. 43 – 45 <p>] Project WET</p> <ul style="list-style-type: none"> • <i>H₂O Olympics</i>, p. 20 • <i>Molecules in Motion</i>, p. 47 | <ul style="list-style-type: none"> • Focus on the modern Periodic Table • Some information beyond the standard • Properties of water • Simulate states of matter |
| <p>If using the <i>Harcourt Science</i> 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 <i>Guide</i></p> | | | |
| MY NOTES | RESOURCES IN THIS GUIDE | NOTES | |
| | <ul style="list-style-type: none"> • Periodic Bingo, pg. 27 | <ul style="list-style-type: none"> • Students become familiar with the structure of the Periodic Table | |



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| Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | Notes | | | | | | |
|---|--|-------|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|----|----|-------|----|----|----|---|--|---|
| | | | PS 1a | PS 1b | PS 1c | PS 1d | PS 1e | PS 1f | PS 1g | PS 1h | PS 1i | 6a | 6b | | 6c | 6g | 6h | | | |
| Evan-Moor Corp, <i>Read and Understand Science, Grades 4-6</i> (EMC 3305) | A Compound Mystery | 65-69 | | | | | | | ▼ | | | | | | ▼ | | | ▼ | | Students read a story, differentiate between a compound and a mixture and write directions for making a compound or mixture “recipe.” |
| | Probing the Periodic Table | 90-94 | | | | ▼ | | | | | | | | | | | | | | Background and vocabulary on the Periodic Table. Some information provided is beyond the standards. |
| FOSS: <i>Mixtures and Solutions</i> | Investigation 1 – Science Stories: <i>Mixtures and Solutions</i> | 3-6 | | ▼ | | ▼ | | | ▼ | | | | | | | | | | | Expository text - some vocabulary extends beyond the standards. |
| | Investigation 1 - Science Stories: <i>Earth Elements</i> | 11-12 | | | | | | | | ▼ | | | | | | | | | | Expository Text |
| | Investigation 4 – Science Stories: <i>Metals</i> | 37-42 | | | ▼ | | | | | | | | | | | | | | | Text on the properties of metals including copper, aluminum, iron, precious metals, alloys and salts. |
| | Investigation 4: Science Stories: <i>What is Matter Made Of?</i> | 25-28 | ▼ | ▼ | | ▼ | ▼ | | | | | | | | | | | | | Images of electron microscope and well-ordered arrays. |
| | Investigation 4 – Science Stories: <i>The Periodic Table</i> | 32-36 | ▼ | | | ▼ | | | | | | | | | | | | | | Focus on the most recent table, pg. 35-36. The history of the Periodic Table is interest only. |
| | Investigation 4 – Science Stories: <i>The History of Rubber</i> | 43-45 | | | | ▼ | | | ▼ | | | | | | | | | | | |

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 1b | PS 1c | PS 1d | PS 1e | PS 1f | PS 1g | PS 1h | PS 1i | 6a | 6b | | 6c | 6g | 6h | |
| | Investigation 4: <i>Metals</i> | 37-42 | | | | ▼ | | | ▼ | | | ▼ | | | | | | Properties of salts |
| Harcourt, Chapter 2, Lesson 1 | Atoms and Elements | C40 | | ▼ | | | | | | | | | | | | | | Text |
| | Elements | C42-43 | | ▼ | | ▼ | | | | | | | | | | | | Text |
| | Metals | C44-45 | | | ▼ | | | | | | | | | | | | | Text |
| Harcourt, Chapter 2, Lesson 2 | Grouping Elements | C46-47 | | | ▼ | | | | | | | | ▼ | ▼ | ▼ | ▼ | ▼ | An activity in which students' group substances by their properties. Aligned with 6b and 6c if <i>Investigate Further</i> is implemented. |
| | Investigate Log | WB 150-151 | | | ▼ | | | | | | | | ▼ | | ▼ | ▼ | ▼ | To be used with activity on pg. C46-47. Aligned with 6c if <i>Investigate Further</i> is completed. |
| | Lesson Concept Review : <i>What Are Compounds?</i> | WB 153 | | ▼ | | ▼ | | | | | | | | | | | | |
| | Elements and Compounds | C48-49 | | | ▼ | ▼ | | | | | | | ▼ | | | | | Text - Graphic of the Periodic Table |
| | Compounds | C50-51 | | | | | | | ▼ | ▼ | | | | | | | | Text |
| | Discovering Elements | C52-53 | | | | | ▼ | | | | | | | | | | | Page C53 has the only image of a atoms arranged in arrays in the text. |
| | Science Through Time: <i>Discovering Elements</i> | C52-53 | | | | ▼ | | | | | | | | | | | | Page C53 has the only image of a atoms arranged in arrays in the text. |

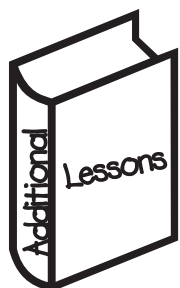
Resources are listed alphabetically by publisher. The symbol (▼) signifies the resource is aligned with one or more key concepts from the identified standard.



| Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | Notes | |
|---|---|------------------------|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|----|----|----|----|----|-------|---|
| | | | PS 1a | PS 1b | PS 1c | PS 1d | PS 1e | PS 1f | PS 1g | PS 1h | PS 1i | 6a | 6b | 6c | 6g | 6h | | |
| Harcourt, Chapter 2 | People in Science: <i>Glenn T. Seaborg: Nuclear Chemist</i> | C54 | | | | | ▼ | | | | | | | | | | | |
| | Activities for Home or School: <i>Periodic Table</i> | C55 | | | | ▼ | | | | | | | | | | | | Students research samples of elements and create a visual representation of the Periodic Table. |
| | Activities for Home or School: <i>Rusty Wool</i> | C56 | ▼ | | | | | | | | | | | | | | ▼ | The rate of steel wool oxidation in salt and fresh water. |
| | Activities for Home or School: <i>Splitting Water</i> | C57 | | | | | | | | | ▼ | | | | | | ▼ | Conductivity of salt in water |
| Harcourt, Chapter 3 | Science Through Time: <i>Developing Sources of Energy</i> | C90-91 | ▼ | | | | | | | | | | | | | | | To be aligned, stress the conservation of matter. |
| Additional Lesson in this Guide to support the Harcourt Program | Periodic Bingo | <i>Guide</i> , page 27 | | | ▼ | ▼ | | | | ▼ | ▼ | | | | | | | Students become familiar with the structure of the Periodic Table. |
| Project WET | H ₂ O Olympics | 30 | | | | | | | | ▼ | | | | ▼ | | | | Students investigate properties of water. |
| | Molecules in Motion | 47 | ▼ | ▼ | ▼ | | | | ▼ | ▼ | | ▼ | | ▼ | ▼ | ▼ | | Students simulate molecules of water in various states of matter |

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





Periodic "Bingo"

Science Standards

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

- 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.
- 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.
- 1h. Students know living organisms and most materials are composed of just a few elements.
- 1i. Students know the common properties of salts, such as sodium chloride (NaCl).

Focus Concepts

- 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).
- An element is made of one kind of atom.
- Elements are grouped on the Periodic Table based on their chemical properties, which are determined by their atomic structure.
- 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.
- 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.
- 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 formed by elements in the groups under sodium and magnesium in combination with elements under fluorine on the Periodic Table.
- Some salts are poisonous.

Purpose

To familiarize students with the Periodic Table, how it is organized, and how it is used as a tool for study.

Background

The *Harcourt Science* text provides a basic overview of the structure and development of the Periodic Table.

The California Department of Education provides a pdf copy of the *Reference Sheet* students will receive when they take the Grade 5 CST. This sheet includes the Periodic Table, sending





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

a clear message that questions on this assessment will not require students to have memorized the Periodic Table, but that students understand how to use the Table to answer questions about common elements, molecules, and compounds.

Periodic Bingo provides students with time to become familiar with the Periodic Table, and provides teachers an opportunity to start discussions about elements and atoms. This lesson can be broken into small pieces, with different sets of questions being used for different games depending on other science instruction being presented. Students might want to research specific topics to create questions for the game as well.

Students were first introduced to the Periodic Table in Grade 3, standard 1i. In this standard, students learn that there are more than 100 different types of elements on the Periodic Table, and that the Periodic Table displays the names and symbols of known elements as well as other information. Students look for familiar elements and those named after people and places.

Preparation

Provide each student with their own Periodic Table. Students might choose to color-code it to identify specific information more easily. These Periodic Table can either be laminated, so that as students mark their choice during the game the marks can be removed for the next game, or students may use “chips” (beans, pennies, or some other marker) to cover squares during the game.

Part 1

Becoming familiar with the Periodic Table
(time to teach: 15 minutes)

Teacher will need:

Overhead projection or poster of the Periodic Table

Students will need: (for each team or individual student)

A copy of the Periodic Table
A way to mark answer choices



Procedures

- To begin this experience, you may want to review some of the content on the Periodic Table from Grade 3.
 - Point out the key to the Periodic Table. Ask what the key tells the reader. (*The number is the atomic number, the large letters are the atomic symbols, the name of each atom is listed below the symbol, and shading or color may indicate whether the atom is a metal, metalloid, or non-metal.*)
 - Ask students if there any elements on the Periodic Table that they recognize. (*Students may mention elements such as gold, silver, copper, iron, or oxygen.*)
 - Ask students to find any elements that might be named after places. (*Students might mention Californium, Berkelium, or others.*)
 - Ask students to find any elements that might be named after people. (*Students might mention Einsteinium and Seaborgium, named after famous scientists e.g. Albert Einstein, Glen Seaborg.*)
 - Ask students if all substances in the world are listed on the Periodic Table. (*No.*) Ask if students can think of a substance that is not on the Periodic Table and why it is not listed. (*Only pure elements are listed on the Periodic Table; if a substance is made of more than one kind of element, it will not be listed.*)
- Getting more familiar with how to find things on the Periodic Table:** Ask students to find *iron* on the Periodic Table. (*Have them put their finger on it.*) Ask them to describe to a friend where iron is located. [*Students might*

Grade 5 Physical Science -

Atoms, Molecules and the Periodic Table Lesson

Los Angeles Unified School District





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

suggest telling their friend the symbol (*Fe*), or having them look for the atomic number (26)]. Ask students to think of additional strategies including coordinates (*row / column*) or properties (*metal*). Share that the columns on the Periodic Table are called *groups* or *families*. The shape and organization of the Periodic Table is based on the elements in the same group having similar chemical properties.

3. Iron is a metal. Ask students if they can find other metals such as aluminum (Al), nickel (Ni), copper (Cu), silver (Ag), and gold (Au). Have students practice finding and describing the location of these elements.
4. Ask students if they can find steel on the Periodic Table. (*No.*) Brass? (*No.*) Ask why they can't find these on the Table. (*They are not pure elements.*)
5. Ask students if they can find a non-metal. (*Have students identify and describe the location.*) Ask students to draw a line between the metals and non-metals. Explain that the elements at that line are called *metalloids* or semi-metals. Ask why they think they are called this. (*These elements have some of the properties of metals and some properties of non-metals.*) Interesting to note: not all Periodic Tables identify the same elements as metalloids and some Periodic Tables call these elements semi-metals.
6. Table salt is NaCl. (*You might want to write this on the board.*) Table salt is made from two elements, Na and Cl.
 - a. Ask students to find what elements these symbols stand for. (*Sodium and chlorine.*) Have students describe the location of these elements to others.
 - b. Ask if sodium and chlorine are metals or non-metals.
 - c. There are many types of salts. Salts are made from elements in the group under fluorine combining with elements in the groups under sodium or magnesium. Some of these combinations can be poisonous.

Part 2

Periodic Bingo – The Rules of the Game (time to teach: 10 minutes)



Teacher will need:

- A prompt and answer sheet
- Recording sheet for prompts used
- Overhead projection or poster of the Periodic Table

Students will need: (for each team or individual student)

- A copy of the Periodic Table (sample provided)
- A way to mark answer choices

The rules of the game:

Note: The purpose of *Periodic Bingo!* is for students to become familiar with the Periodic Table, reducing anxiety about the tool and building fluency in locating elements by different criteria. There is no reason for students to memorize the Periodic Table.

1. In order for students to “win” a point for their team, they must have at least 3 elements in a row identified. A row can be vertical, horizontal, or diagonal.
2. When a student has created a row, he/she raises his/her hand and says “bingo!”
3. The teacher (or designated student) can check that the answers are correct. A point is given to the team, and the current markers are removed from the board before the game continues. The teacher can determine how many points are needed for the team to win the game.

Sample prompts and Answers

The following prompts are in no particular order. Teachers might choose to cut them out and put them in a bag to be selected randomly.

Grade 5 Physical Science-

Atoms, Molecules and the Periodic Table Lessons

Los Angeles Unified School District





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

| Prompt | Answer |
|---|-------------------------------------|
| One of the most common elements in the Earth's crust; a silver-colored metal that is used to make things such as baseball bats and soda cans. | aluminum |
| The elements that make up methane (CH ₄) and propane (C ₃ H ₈) | carbon and hydrogen |
| The elements that make up sugar (C ₆ H ₁₂ O ₆) | carbon, hydrogen, and oxygen |
| The elements that combine to make brass | copper and zinc |
| A pale yellow, poisonous gas that does not conduct electricity. It has an atomic number of 9 | fluorine |
| An element named after a country | Francium, Americium |
| A yellow solid with a luster. It is malleable and conducts electricity. It is commonly used as jewelry, and many people once moved to California in search of it. | gold |
| An element named after the scientist who reorganized the Periodic Table into its current form. He also led a team that created an element called plutonium. | seaborgium named after Glen Seaborg |
| A non-metal, found in family 17, that is used to test for the presence of starch | iodine |
| The only non-metal in group 1 | hydrogen |
| The element family 9 that is found naturally, and has an atomic number higher than 70 | iridium |
| A solid at room temperature that is malleable and conducts electricity. It reacts with oxygen to turn the metal a reddish color that we call rust. | iron |

| Prompt | Answer |
|---|--|
| The elements that combine to form MgCl ₂ | magnesium and chlorine |
| A metal that is liquid at room temperature. Some thermometers are still made with it, but most now use alcohol. | mercury |
| The element that makes electric signs light with intense color | neon |
| The elements that make up carbon dioxide (CO ₂) | oxygen and carbon |
| The elements that make up water (H ₂ O) | oxygen and hydrogen |
| The element in row 5, group 8 | ruthenium |
| A commonly used metal in jewelry from the southwest | silver |
| The elements that combine to make bronze | copper and tin |
| The 6 elements most commonly found in living organisms | phosphorus, carbon, oxygen, hydrogen, nitrogen, and sulfur. |
| The 8 most commonly found elements in the Earth's crust | oxygen, silicon, aluminum, iron, calcium, sodium, potassium, and magnesium |





Chemical and Physical Reactions

The *Chemical and Physical Reactions* unit provides students with a basic foundation in chemistry by exploring the physical and chemical properties of common mixtures and compounds. They learn to differentiate between chemical and physical (mechanical) processes while exploring a variety of common elements and molecules.

This unit provides students with a foundation for study of the structure of matter (standards 3a – f) and reactions (standards 5a-e) in Grade 8.

Across Los Angeles there are many resources to support an enriched study of chemistry. The city's museums often provide a wide variety of resources, curriculum, and field trip opportunities that focus on basic chemistry principles. Local agencies and businesses, depending on their focus, may also provide enriching experiences that deepen students' understanding of the content they are learning. 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, 1f - g, and 1i, with significant support for building science process skills in the I&E standards 6a - i.

California Academic Content Standards:

- 1a. *Students know* that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
- 1f. *Students know* differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.

- 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).
- 1i. Students know the common properties of salts, such as sodium chloride (NaCl).
- 6a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
- 6b. Develop a testable question.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6d. Identify the dependent and controlled variables 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.
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- 6h. Draw conclusions from scientific evidence and indicate whether further 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.

Vocabulary –The core vocabulary for the *Chemical and Physical Reactions* unit focuses on describing the changes that

Grade 5 Physical Science-
Chemical/Physical Reactions Introduction

Los Angeles Unified School District





occur during chemical and physical (mechanical) processes. Additional vocabulary reflects terminology students may have been introduced to in Grades K-3, and terms that they will become familiar with as a result of activities in chemistry. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons – The additional lessons for this unit are: *What Am I?*, and *Rearranging Molecules*.

Critical Questions

- What physical and chemical properties can be used to separate mixtures, identify compounds, or identify metals?
- What are some common properties of salts?



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., *solution*, *base*, *compound*).

Health: Students can relate their study of chemistry with topics related to personal health and safety. Students may be interested in why salt tablets are given to those working in hot climates. Students may read about gas emissions in local news articles and how these emissions influence the location of buildings and the general health of a community.

Visual and Performing Arts: Students working with clay, metal, and other materials to build sculptures and other 3-dimensional art use chemistry for glazing, soldering, gluing, etc. Students might examine their artwork through a “chemist’s eye” to explore the art of chemistry.

Background

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

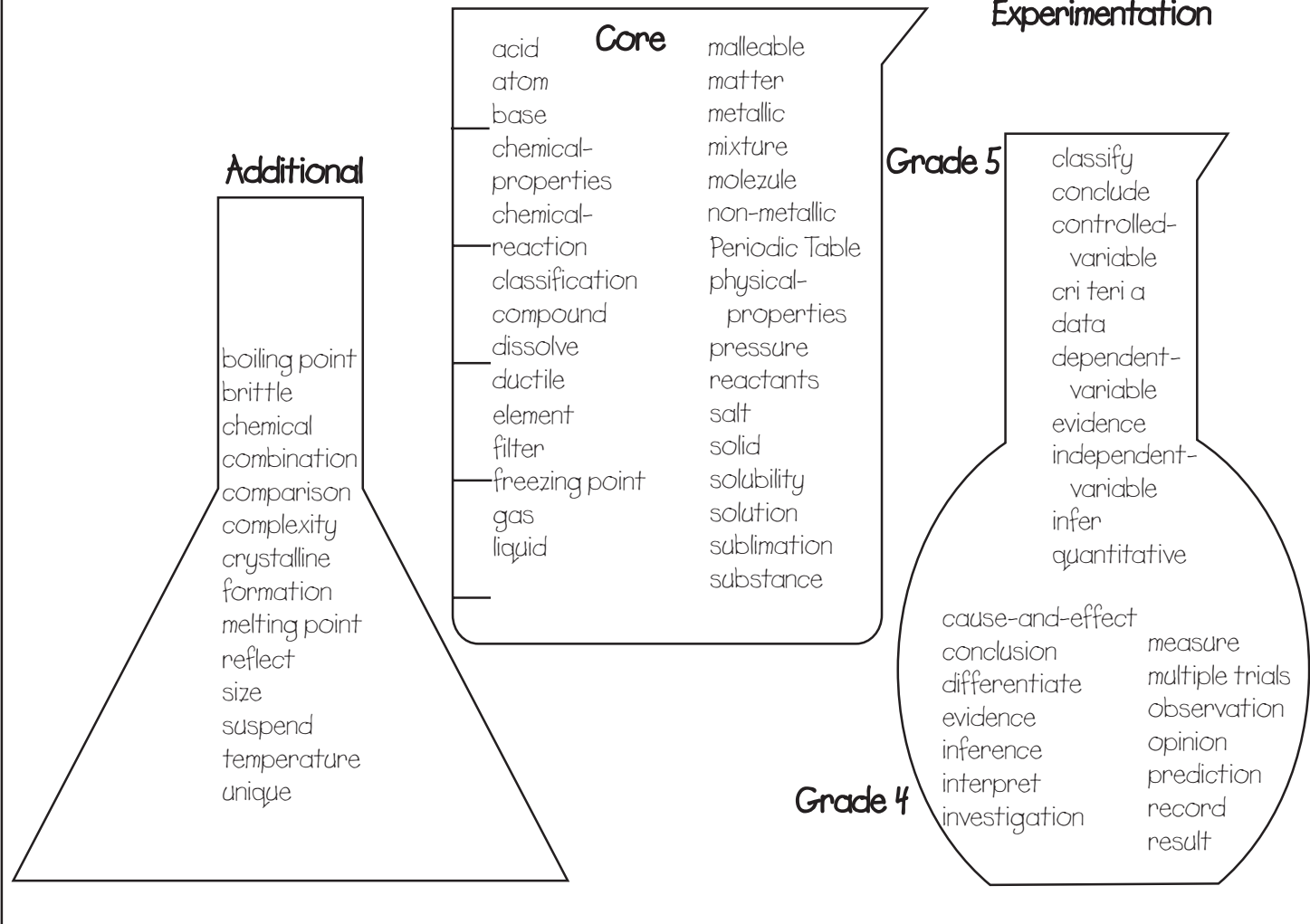
- In this unit there are many opportunities for students to collect data and display it graphically. Students may find which type of graphic illustration to use when charting data to be very challenging. By providing students with multiple opportunities to choose between bar, line, and pie graphs, and asking students to justify their selections, students will become more adept at choosing the correct graphic illustration for charting data.
- Standard 6i can be assessed well by student performance. Students should practice writing a report of a science investigation in which students have conducted tests, collected data on each test or examined evidence, and drawn conclusions based on a close examination of the evidence or data. An example of an experience that supports this standard is the *Immersion Unit* for this module.
- When performing activities, investigations or experiments related to chemical and physical reactions, all safety precautions should be taken. When safety is a concern, the teacher may choose to demonstrate a reaction in order to ensure the safety of students.
- Students should have access to safety goggles and use them appropriately. Appropriate District Bulletins on safety and use of chemicals at the elementary level should be consulted before undergoing any hands-on experience involving chemical reactions.

“It may well be that men of science, not kings, or warriors, or even statesmen are to be the heroes of the future.”
- William Robertson Smith and Charles A. Beard, *The Development of Modern Europe* (1908)



Grade 5 Vocabulary Chemical and Physical Reactions

Investigation & Experimentation





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d**California Academic Content Standards:**

- 1a. *Students know* that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
- 1f. *Students know* differences in chemical and physical properties of substances are used to separate mixtures and identify compounds.
- 1g. *Students know* properties of solid, liquid, and gaseous substances, such as sugar (C₆H₁₂O₆), water (H₂O), helium (He), oxygen (O₂), nitrogen (N₂), and carbon dioxide (CO₂).
- 1i. *Students know* the common properties of salts, such as sodium chloride (NaCl).
- 6a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
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- 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.
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- 6h. Draw conclusions from scientific evidence and indicate whether further 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.

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|  | HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | |  |
|---|--|--|--|--|---|
| | RESOURCE | NOTES | RESOURCES | NOTES | |
| | Chapter 1 <ul style="list-style-type: none"> Lesson 1, <i>How Can Physical Properties Be Used to Identify Matter?</i> pg C4 – 11 WB 132-133 Lesson 2, <i>How Does Matter Change from One State to Another?</i> pg. C12-19 WB 136-137 Investigation Challenge, p. C18 | <ul style="list-style-type: none"> <i>Density</i> is mastered in Grade 8 Focus on states of matter, melting and boiling points | FOSS: Mixtures and Solutions, Investigation 1, <u>Science Stories</u> <ul style="list-style-type: none"> <i>Mixtures and Solutions</i>, pg. 1-6 <i>A Salty Story</i>, pg. 7-10 | <ul style="list-style-type: none"> Mostly connections to Social Studies | |





HARCOURT SCIENCE TEXTBOOK

 SUPPLEMENTAL
 * Resources are organized by topic


| RESOURCE | NOTES | RESOURCES | NOTES |
|--|-------|---|--|
| <ul style="list-style-type: none"> Lesson 3, <i>How Does Matter React Chemically?</i> pg. C20 – 27 WB 140-141 WB 143 Investigation Challenge, p. 26 <p>People in Science</p> <ul style="list-style-type: none"> Theophilus Leapheart, pg. C30 <p>Activities for Home or School</p> <ul style="list-style-type: none"> <i>Mix it Up</i>, p. C31 <i>Cabbage Juice Indicator</i>, p. C32 <i>Pennies and Paper Clips</i>, p. C33 <i>Hot or Cold</i>, p. C33 <p>Performance Assessment, pg. AG 69-70</p> | | <p>Compounds and Mixtures</p> <p>FOSS: Mixtures and Solutions, Investigation 1</p> <ul style="list-style-type: none"> <i>Separating Mixtures</i> <p>Investigation 3, <u>Science Stories</u></p> <ul style="list-style-type: none"> <i>Grow Your Own Crystals</i>, pg. 18-19 <p>Investigation 4, <u>Science Stories</u></p> <ul style="list-style-type: none"> What a Reaction! pg. 23 – 24 <p>Investigation 4, <i>Fizz Quiz</i></p> <p>Project WET</p> <ul style="list-style-type: none"> <i>Is There Water on Zork?</i>, p. 43 <i>What's the Solution?</i> p. 54 <i>Irrigation Interpretation</i>, p. 254 | <ul style="list-style-type: none"> Focus on separation of mixture by evaporation Focus on physical properties; safety precautions needed Read in context; high interest read, low content Properties of water Properties of water Connections to environmental education |

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 |
|----------|---|--|
| | <ul style="list-style-type: none"> What Am I?, pg. 41 Rearranging Molecules, pg. 45 | <ul style="list-style-type: none"> Students identify an unknown substance Students practice conservation of matter |



| S | Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | | | | Notes | |
|---|--------|--|-------|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|----|----|----|----|----|----|----|----|-------|--|
| | | | | PS 1a | PS 1b | PS 1c | PS 1d | PS 1e | PS 1f | PS 1g | PS 1h | PS 1i | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i |
| t a n d a r d s A l i g n m e n t | | Investigation 1 – Science Stories: <i>Mixtures and Solutions</i> | 3-6 | | ▼ | | ▼ | | ▼ | | | | | | | | | | | | | Expository text - some vocabulary is beyond the standards. |
| | | Investigation 1 – Science Stories: <i>Salty Story</i> | 7-10 | | | | | | | | ▼ | | | | | | | | | | | Connects to History – Social Studies. |
| | | Investigation 1 – part 1: <i>Making and Separating Mixtures</i> | 1-15 | | | | | | ▼ | | | | ▼ | | | | ▼ | | ▼ | | | An inquiry investigation on separating mixtures. |
| | | Investigation 1 – part 2: <i>Separating a Salt Solution</i> | 16-20 | | | | | | ▼ | | | | | | | | ▼ | | | | | Focus on separation of a mixture by evaporation |
| | | Investigation 1 - part 3: <i>Observing Crystals</i> | 22-24 | | | | | | ▼ | | | | | | | | | | | | | Focus on separation of a mixture by evaporation |
| | | Investigation 1 - part 4: <i>Separating a Dry Mixture</i> | 25-27 | | | | | | | | | | | ▼ | | ▼ | | ▼ | | | ▼ | Plan how to separate a mixture of solids |
| | | Investigation 3: <i>Grow Your Own Crystals</i> | 18-19 | | | | | ▼ | | | | | | | | | | | | | | Focus is to take Borax out of solution. Take care in boiling water with Borax. |
| | | Investigation 4: <i>Fizz Quiz</i> | 1-30 | ▼ | | | | | | ▼ | | | | | | | | | | ▼ | | An investigation on chemical reactions. |



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

| 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 | |
|--|--------|--|------------|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|----|----|----|----|----|----|----|----|-------|---|
| | | | | PS 1a | PS 1b | PS 1c | PS 1d | PS 1e | PS 1f | PS 1g | PS 1h | PS 1i | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i |
| | | Investigation 4 – Science Stories: <i>What a Reaction</i> | 23-25 | ▼ | ▼ | | | | | | | | | | | | | | | | | Describes what a chemical reaction is. |
| | | Investigation 4: <i>Metals</i> | 37-42 | | | | ▼ | | ▼ | | | ▼ | | | | | | | | | | Properties of salts |
| | | Investigation 4 - part 4: <i>Choose Your Own Investigation</i> | 25-28 | | | | | | | | | | | | | ▼ | | | ▼ | | | |
| Harcourt, Chapter 1, Lesson 1 | | Using Physical Properties to Identify Objects | C4-5 | | | | | | | | | | | ▼ | | | | | ▼ | | ▼ | An activity in which students observe and describe apples. |
| | | Investigate Log | WB 132-133 | | | | | | | | | | | | ▼ | | | | | | | To be used with activity on pg. C4-5 |
| | | The Importance of Physical Properties | C6 | | | | | | ▼ | | | | | | | | | | | | | Text |
| | | Mass and Weight; Volume | C7-8 | | | | | | | | | | | | | | | | ▼ | | | Weight versus mass and finding the volume of an irregular shaped object |
| | | Mixtures and Solutions | C10-11 | | | | | | | ▼ | | | | | | | | | | | | |
| | | Changing States of Matter | C12-13 | | | | | | | ▼ | | | | | | | | | ▼ | | ▼ | An activity on mass and state of matter. |

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 1b | PS 1c | PS 1d | PS 1e | PS 1f | PS 1g | PS 1h | PS 1i | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | 6i | | |
| Harcourt, Chapter 1, Lesson 2 | Investigate Log | WB 136-137 | | | | | | | ▼ | | | | | | | | ▼ | | ▼ | | To be used with activity, <i>Changing States of Matter</i> , pg. C12-13 | |
| | Changes in State | C14-17 | | | | | | | ▼ | | | | | | | | | | | | Text - Focus on properties of solids, liquids and gases | |
| | The Inside Story | C16-17 | | | | | | | ▼ | | | | | | | | | | | | Illustration of the changing states of matter. | |
| | Freezing Points | C18 | | | | | | | ▼ | | | | | | | | | ▼ | ▼ | | ▼ | Text |
| | Investigation Challenge: <i>Freezing Points</i> | C18 | | | | | | | | | | | | | | | | | | | | Students determine the effect of salt on the freezing point of water. |
| | Melting and Boiling Points | C18-19 | | | | | | | | ▼ | | | | | | | | | | | | Text |
| Harcourt, Chapter 1, Lesson 3 | Chemical Properties | C20-21 | | | | | | | ▼ | | | | | ▼ | | ▼ | ▼ | | | ▼ | ▼ | An activity on chemical reactions that can be simplified by using cups instead of test tubes. Use buckets of soapy/fresh water to clean up. Aligned with 6d if dependent and independent variable are stressed |

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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| Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | | | | | Notes | |
|------------------------|--|------------|----------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----|----|----|----|----|----|----|----|----|-------|---|
| | | | PS 1a | PS 1b | PS 1c | PS 1d | PS 1e | PS 1f | PS 1g | PS 1h | PS 1i | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | 6i | | |
| | Investigate Log | WB 140-141 | | | | | | ▼ | | | | | ▼ | ▼ | ▼ | | | | | | | To be used with the investigation, <i>Chemical Properties</i> , pg. C20-21 |
| | Lesson Concept Review : <i>How Does Matter React Chemically?</i> | WB 143 | | | | | | ▼ | | | | | | | | | | | | | | Focused on vocabulary, <i>reactivity</i> and <i>combustibility</i> . |
| | Changes in Matter | C22-25 | ▼ | | | | | ▼ | | | | | | | | | | | | | | Text |
| | Conservation of Matter | C26 | | | | | | | | | | | | | | | | | | | ▼ | Text - Use of process skills |
| | Investigation Challenge: <i>Conservation of Matter</i> | C26 | | | | | | | ▼ | | | | | | | | | | | | | Builds familiarity with properties of water as it changes from a liquid to a solid. |
| Harcourt, Chapter 1 | People in Science: <i>Theophilus Leapheart: Chemist</i> | C30 | | | | | ▼ | | | | | | | | | | | | | | | |
| | Activities for Home or School: <i>Mix it Up</i> | C31 | ▼ | | | | | ▼ | | | | | | | | | | | | | ▼ | Separating a mixture using chromatography |
| | Activities for Home or School: <i>Cabbage Juice Indicator</i> | C32 | | | | | | ▼ | | | | | | | | | | | | | ▼ | An alternative to using iodine to indicate pH. |

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| Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | | | | | Notes |
|--|---|------------------------|----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|----|----|----|----|----|----|----|----|----|---|
| | | | PS 1a | PS 1b | PS 1c | PS 1d | PS 1e | PS 1f | PS 1g | PS 1h | PS 1i | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | 6i | |
| | <i>Activities for Home or School: Hot or Cold</i> | C33 | | | | | | | | ▼ | | | | | | | | | ▼ | | The effect of salt on the boiling point of water |
| | <i>Activities for Home or School: Pennies and Paper Clips</i> | C33 | | | | | | | ▼ | | | | | | | | | | ▼ | | Chemical change |
| | <i>Performance Assessment: A Disappearing Act!</i> | AG 69-70 | | | | | | | | ▼ | | | | ▼ | ▼ | | | | ▼ | ▼ | Aligned with 6g if you chart and graph dissolving speeds. |
| Additional lessons in this <i>Guide</i> to support the <i>Harcourt</i> Program | What Am I? | <i>Guide</i> , page 41 | ▼ | | | ▼ | | | | | | | ▼ | | ▼ | ▼ | | | ▼ | ▼ | Students practice identifying unknown liquids. |
| | Rearranging Molecules | <i>Guide</i> , page 41 | ▼ | ▼ | | ▼ | | | | | | | | | | | | | | | Rearranging atoms into molecules. |
| Project WET | Is There Water on Zork? | 43 | ▼ | | | ▼ | | | ▼ | ▼ | | | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | Students distinguish water from other liquids |
| | What's the Solution? | 54 | ▼ | | | | | | | | | | | | | | ▼ | ▼ | | | Students investigate the dissolving power of water. |

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.

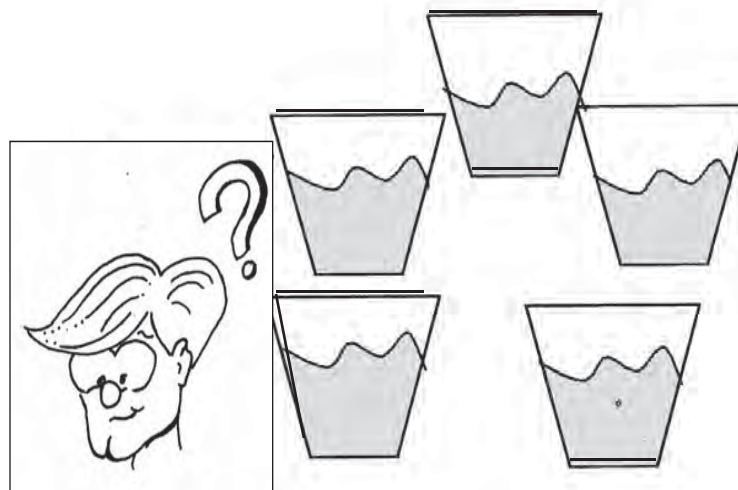
What am I? - Identifying Liquids

Science Standards

- 1a. *Students know* that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
- 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.
- 6a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
- 6d. Identify the dependent and controlled variables 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.
- 6h. Draw conclusions from scientific evidence and indicate whether further 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.

Focus Concepts

- Properties are used to identify atoms, elements, molecules, and compounds.
- Reactants and products can be identified when observing a chemical reaction.
- The physical and chemical properties of an element are



- determined by the properties of its atoms.
- Students classify objects using a set of criteria.
- Students identify the dependent variable in an investigation.
- 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.
- Students draw conclusions from scientific evidence.
- Students determine if more information is needed to support a specific conclusion.
- Students write a report of an investigation that includes sections on conducting tests, collecting data or examining evidence, and drawing conclusions.





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

Purpose

To identify substances based on physical and chemical properties.

Background

The *Harcourt Science* text provides information on the physical and chemical properties of common substances, but students may need additional support for some of the concepts that are not covered extensively in the text.

This investigation can be implemented as a diagnostic tool to determine how much the students know about experimental design, or it can be done in a more teacher-directed fashion. The explanation below is provided in a teacher-directed model, from which more student direction can be embedded as desired.

Preparation

Students will need access to unknown substances. Create containers or cups of each substance, labeling it with letters (a,b,c...) or numbers (1,2,3...). There should be a waste bucket for students to use when they complete a test so that they do not contaminate their unknowns.

The substances include: water, white vinegar, hydrogen peroxide, corn syrup, rubbing alcohol, mineral oil or glycerin, and clear soda. (Note that some of these substances are harmful if swallowed or splashed in eyes.)

Procedures

Students will need:
(for each team or individual)

A set of unknown liquids
Testing materials (choose one or more from each group)

Surface tension: Pepper, wax paper, paper clips, toothpicks, liquid soap

Solubility: salt, sugar, baking soda, corn starch



Chemical reactions: baking soda, aluminum foil
Evaporation / condensation: hot and cold water

(time to teach: 45 minutes)

1. This lab can begin with a scenario such as telling students that you have a number of substances, but because the containers were not labeled, you don't know which one is which. Tell the students what the choice of substances are. Have them observe each substance and make initial predictions of the identity of each unknown substance. (*The upper left hand box on the student recording sheet.*)
2. Discuss how each substance has different properties that make it unique. In order to test an unknown substance, it is necessary to have a known substance to compare. Students might choose water as the known substance, since it is easily accessible and they may know some facts about what makes water unique.
3. Introduce students to the first set of materials they will use to test the substances. Talk about this experimental design. If the same testing material is used with a known and an unknown substance, identify the independent and dependent variables. (*The testing material and water are the independent variables, and the unknown substance is the dependent variable - record information on the first line of the student recording sheet.*)
4. Give each team an unknown substance and a material for testing. Allow students to perform their test and record their data. Discuss and share the data gathered by each team and give students an opportunity to change their predictions about each substance's identity. (*Line 2 of the student data recording sheet.*)



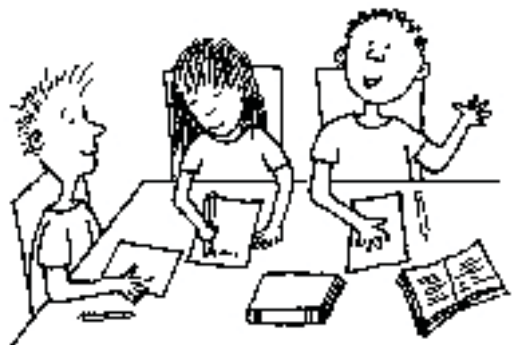


This sample instructional activity illustrates possible strategies for accessing the content within the standards.

5. Introduce students to the second set of materials they will use to test the substances. Using the same unknown substance, have students perform this next test, record and discuss their results.
6. Continue until students can verify with two tests which of the unknown substances is water, and make reasonable conclusions about the other substances. Since substances such as rubbing alcohol are mostly water, talk about how the properties of alcohol make the properties of rubbing alcohol different from water. Discuss what additional information might be needed to determine the identity of each unknown substance.
7. Students can formally write up their lab investigation, including materials, procedures, data, results and conclusions to practice communicating scientifically.

Discussion Starters

- How did the different tests you performed help you determine the identity of the unknown liquid?
- Which tests were the most conclusive and why?
- Which tests require a chemical reaction and which are physical changes? How do you know?



Sources Used in Developing This Lesson

Water Education for Teachers, Project WET: *Is There Water on Zork?* Pg. 43 - 46

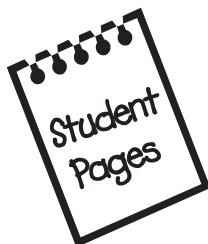


Name: _____

What am I? - Data Reporting Sheet

| Predictions: | Type of Test | Independent variable(s) | Dependent variable(s) | Results |
|--------------|--------------|-------------------------|-----------------------|---------|
| | | | | |
| | | | | |
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Conclusions:





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

Rearranging Molecules

Science Standards

Connections to Physical Science:

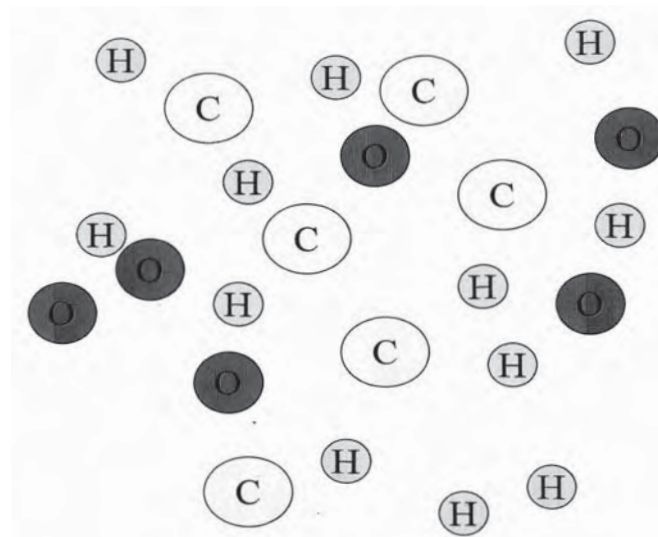
- 1a. Students know that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
- 1b. Students know all matter is made of atoms, which may combine to form molecules.
- 1d. Students know that each element is made of one kind of atom and that the elements are organized in the periodic table by their chemical properties.
- 1h. Students know living organisms and most materials are composed of just a few elements.

Connections to Life Science:

- 2f. Students know plants use carbon dioxide (CO_2) and energy from sunlight to build molecules of sugar and release oxygen.
- 2g. Students know plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO_2) and water (respiration).

Focus Concepts

- An element is made of one kind of atom
- When atoms in molecules rearrange, no atoms are lost.
- When atoms rearrange, they form new combinations with different properties (conservation of matter).
- 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).

- Simple molecules can be represented by molecular models to enhance student understanding of symbolic representations of molecules in text.
- 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.





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

Purpose

This activity allows students a tactile experience to combine and rearrange atoms to form simple molecules. The example provided here shows the relationship (at an equation level) between photosynthesis and cellular respiration. Students might make connections to their work in mathematics on balancing equations. Students can do this activity before or after they have studied the physical science module.

Preparation

Prepare items to symbolize the different elements. Colored math manipulatives or a variety of candy work well. In this description, the following types of candy are used:

- Raisins for oxygen
- Gummy bears for carbon
- Mini-marshmallows for hydrogen

Students can bring in supplies or determine the manipulatives to depict each element if preferred.

You might want to prepare bags with enough of each candy for students to build their models. Otherwise, students can collect their supplies from a central location as needed.



Procedures

(time to teach: 30 – 45 minutes)

Students will need: (for each pair)

Student recording sheet
Bag of candy / manipulatives
toothpicks

1. Students may want to wash their hands and do this work on a paper towel so that they can eat the candy when they are done.

2. Discuss with students how everything is made of atoms, from the largest building to the smallest animal. The word *atom* means “the smallest that cannot be divided” in Latin. Although we can split atoms, the smallest substance that maintains the characteristics of the element is the atom. Sometimes atoms of the same element combine to form molecules, and sometimes atoms of different elements combine to form molecules of compounds such as water. A molecule is the smallest particle of a compound, as an atom is the smallest particle of an element. Scientists have discovered how many of each kind of elements’ atoms are needed to make common molecules – like a recipe.
3. Hand out the student sheet. Discuss how the student sheet shows the symbolic representation, or formula, for some common molecules. Remind students that the letters represent the kind of atom (they can look on the Periodic Table to identify what each symbol stands for) and the small numbers after the letter tell them how many of the atoms are in that molecule. Using the materials in their bag and the toothpicks, have students, in teams, build the first set of molecules (water and carbon dioxide). Check the teams’ work.
4. When students have completed their models, have them return any extra manipulatives.
5. Next, explain to students that when carbon dioxide and water are in the presence of chlorophyll and sunlight, plants are able to break the bonds (the toothpicks) and rearrange the atoms to make sugars.
6. Have students create the glucose molecule using the same manipulatives that the used to make the water and carbon dioxide. When they are finished, ask what is left over (12 oxygen atoms).





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

- Oxygen atoms are commonly found in molecules (pairs of 2 atoms). What do you think the plant does with the oxygen molecules that are left over from making sugar? *(They release them into the air and they're available to breathe.)*
- When plants need energy, do you think they can reverse this process? *(Yes, it's called cellular respiration. In the presence of oxygen but in the absence of light, plants break the bonds of the sugar for energy and the atoms rearrange into carbon dioxide and water - just like animals do.)*
- Based on this experience, ask students to generate the equations for photosynthesis and cellular respiration.
- Discuss with students how the very few "building blocks" of carbon, oxygen, hydrogen, nitrogen, sulfur and phosphorus are combined and rearranged in multiple ways resulting in the wide variety of life on Earth.



Discussion Starters

- Describe chemical notation (i.e. H_2O): what do the letters (atomic symbols) and numbers represent?
- Why do scientists create models to show how processes work?
- How does the model created in this activity help you better understand conservation of matter?



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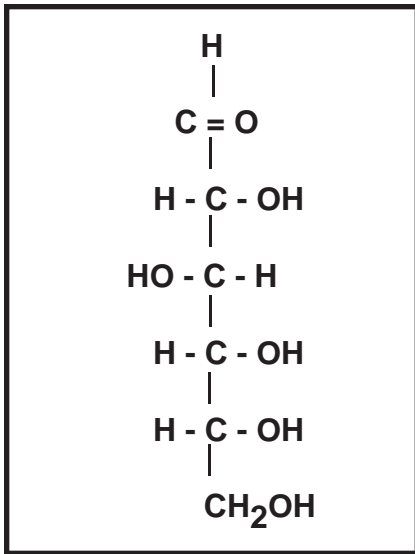
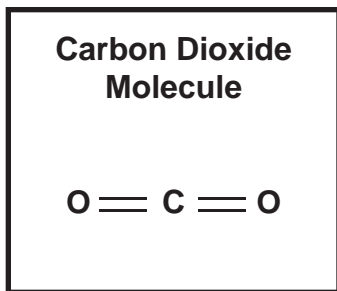
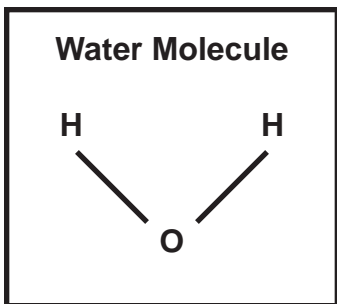
Rearranging Molecules

You will need:

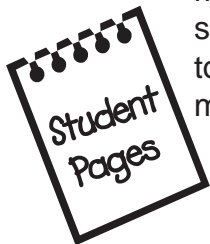
Bag of manipulatives

Toothpicks

Build 6 models of each of the following (the lines represent the connection between the atoms. You will use toothpicks to show these connections):



Imagine that a great source of energy (Sunlight) enters the system and breaks all the connections between your atoms. These atoms now get mixed up. Use these same manipulatives to make a sugar molecule.



After making the sugar molecule, what manipulatives were left over?

What did these manipulatives represent?

In this process, were any atoms lost or unused?

Your model went through three stages:
Stage 1: hydrogen, oxygen, and carbon by themselves
Stage 2: the atoms arranged into the molecules of water and carbon dioxide
Stage 3: the atoms rearranged into sugar and oxygen.

What were the properties of each molecule at each stage?

How can most living organisms be composed of just a few elements (carbon, oxygen, hydrogen, nitrogen, sulfur, and phosphorus) given the variety of living things on Earth?



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

Developed based on design by Diana Roston, LAUSD teacher.

Module Planning Calendar

| 5 | Unit of Instruction: | Selected Resource(s): | Assessment: | 6 | Unit of Instruction: | Selected Resource(s): | Assesment: |
|------------------------|--------------------------------|-----------------------|-------------|------------------------|--------------------------------|-----------------------|------------|
| 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 | | | |

Developed based on design by Diana Roston, LAUSD teacher.



Grade 5 Life Science

Introduction

In Grade 5 life science, students begin to examine the internal structures of plants and animals and how these structures perform the vital functions for survival. This area of study, commonly referred to as physiology, is developed further in Grade 7 and 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 observe the external characteristics of plants and animals and are able to identify the major external structures. In Grade 1, students examine how the external structures of a plant or animal help it thrive in its environment, what the basic needs of organisms are for survival (water, food / energy), that an organism’s external structure relates to a specific function, and that plants and animals are interdependent in a variety of ways. In Grade 2, students are introduced to the concept of life cycles including inherited traits and variation between organisms of the same species as well as the impact of a changing environment on the survival of organisms. In Grade 3, students examine specialized structures in organisms, that different organisms live in different environments, and that a changing environment can have a positive or negative impact on the survival of an organism. In Grade 4, students deepen their understanding of ecosystems and explore the interdependent roles of organisms within food chains and food webs.

The content for Grade 5 deepens students’ understanding of

previously learned material, and prepares them for deeper study of physiology and the interdependence between the survival of organisms and a changing environment in Grade 7.

This module of the *Instructional Guide* is designed to provide teachers with a variety of resources to support implementation of the Grade 5 life 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 life 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 5 Life 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. Core Vocabulary refers to terminology all students should master as a result of instruction. Additional Vocabulary refers to terms 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 reviewing and refining student understanding of the processes from Grade 4.

Immersion Unit - The Grade 5 life science Immersion Unit examines the similarities and differences in how plants and animals solve their needs for survival. Students are provided with a process for researching the structures and functions of a variety of plants and animals to generalize their understanding of how organisms transport materials internally including the work of respiration, digestion, and removal of waste.

Units of Instruction – The units of instruction for Grade 5 life science include: *Animal Structures* and *Plant Structures*. 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 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 5 Life Science Module, both units of instruction 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, and 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 items on each of the Grade 4 standards in addition to all but one of the Grade 5 standards (standard 3e). In examining the test blueprint, nine (9) items on the test will be aligned with the five





Grade 5 Life Science standards. Since all life science standards will be tested with at least one question, students should have a foundational understanding of the content in each of the Grade 5 life science standards.

- Particular care should be taken to discuss the terms “independent variable,” “dependent variable,” and “controlled variable.” These terms are used in the *California Science Framework*, and specific questions may be asked about these terms on the Grade 5 California Standards Test in science. In the words of the standards, “Scientific progress is made by asking meaningful questions and conducting careful investigations.” In any investigation, there are factors (variables) that you control or accept (controlled or independent variables), and those that are dependent upon the question you are asking (dependent variables). The terms *controlled* and *independent* variables are used interchangeably in many texts all the way through high school, and even in some college texts (although the difference relates to the types of factors studied). Typically, a controlled variable is one that you not only control, you can manipulate. Typically, an independent variable is also one that you control (how often you make your observations), but do not manipulate (for example, you don’t change the number of minutes in an hour). Because you do have control over both of these variables, the terms are used interchangeably at this level by many texts, but there is a subtle distinction.

“The whole secret of the study of nature lies in learning how to use one’s eyes.”
 - George Sand
 (Armandine Aurore Lucile Dupin), *Nouvelles Lettres d’un voyageur* (1869)

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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 CO₂) 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 (CO₂) and oxygen (O₂) 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.

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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 (CO₂) 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 $(6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2)$. 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 (CO₂) 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 $(\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O})$. 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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**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.

| K | Grade 5 - Science Content Standards Investigation and Experimentation | Key Knowledge and Concepts from the California Science Framework |
|---|--|---|
| e | 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations. | <ul style="list-style-type: none"> • Students select tools that are appropriate for what students need to measure. • Students make quantitative observations. |
| y | | |
| k | 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data. | <ul style="list-style-type: none"> • Students record data using graphic representations. • Students use graphically represented data to make reasonable inferences. |
| n | | |
| o | 6h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion. | <ul style="list-style-type: none"> • Students draw conclusions from scientific evidence. • Students determine if more information is needed to support a specific conclusion. |
| w | | |
| i | 6i. Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions. | <ul style="list-style-type: none"> • Students write a report of an investigation that includes sections on conducting tests, collecting data or examining evidence, and drawing conclusions. |
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Grade 5 Life Science Vocabulary

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

arteries
atrium
bladder
carbon dioxide (CO₂)
cardiovascular
cells
cellular respiration
chemical reaction
circulation
circulatory system
compound
digestion
heart chambers
kidney
lungs
multicellular organisms
oxygen (O₂)
phloem
photosynthesis
respiration
sugar (C₆H₁₂O₆)
vacuole
vascular plant
veins
ventricle
xylem

Additional

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



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

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 (CO₂) - 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 (O₂) - 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 (C₆H₁₂O₆) - 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.



Periodic Assessment

As an integral element of the *Elementary Periodic Assessment Program*, the Grade 5 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 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 5, Life 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 life 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 Assessment Blueprint

| Standards | # Items |
|---|----------|
| 2. Plants and animals have structures for respiration, digestion, waste disposal, and transport of materials. As a basis for understanding this concept: | 22 items |
| 2a. <i>Students know</i> many multicellular organisms have specialized structures to support the transport of materials. | 3 |
| 2b. <i>Students know</i> 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. | 3 |
| 2c. <i>Students know</i> 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. | 4 |
| 2d. <i>Students know</i> the role of the kidney in removing cellular waste from blood and converting it into urine, which is stored in the bladder. | 2 |
| 2e. <i>Students know</i> how sugar, water, and minerals are transported in a vascular plant. | 2 |
| 2f. <i>Students know</i> plants use carbon dioxide (CO ₂) and energy from sunlight to build molecules of sugar and release oxygen. | 4 |
| 2g. <i>Students know</i> plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO ₂) and water (respiration). | 4 |





| 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. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria. | ✓ | |
| 6b. Develop a testable question. | | |
| 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure. | | |
| 6d. Identify the dependent and controlled variables 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. | | |
| 6f. Select appropriate tools (e.g., thermometers, metersticks, balances, and graduated cylinders) and make quantitative observations. | | |
| 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data. | | |
| 6h. Draw conclusions from scientific evidence and indicate whether further 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. | | |
| Total Items | | 25 |

Sample Items

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 5 standard science 2b. "*Students know* how blood circulates through the heart chambers, lungs, and body and how carbon dioxide (CO₂) and oxygen (O₂) are exchanged in the lungs and tissues." The examples show a range of difficulty and can be used to give students practice in responding to rigorous multiple choice questions.

1. Blood circulation is responsible for ___ **A**

- A. transporting nutrients and oxygen (O₂) to each cell and removing carbon dioxide (CO₂) and waste.
- B. transporting carbon dioxide (CO₂) and waste to the brain and removing nutrients and oxygen (O₂).
- C. transporting nutrients and oxygen (O₂) to the lungs and removing carbon dioxide (CO₂) and waste.
- D. transporting carbon dioxide (CO₂) and waste to the heart and removing nutrients and oxygen (O₂).

2. In humans, the correct order for oxygen (O₂) moving to the cells is ___ **D**

- A. from the body to the heart.
- B. from the lungs to the body.
- C. from the body to the lungs.
- D. from the heart to the body.





Question #1 requires students to understand the role of blood circulation. This question requires students to know that the blood carries oxygen and nutrients throughout the body and removes carbon dioxide and waste.

Question #2 requires students to understand the path of oxygen from the lungs, through the heart, and to the body.

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 | 2b | A | (a) The answer is correct. (b) This statement is the opposite of the correct answer. (c) Oxygen is acquired in the lungs and carbon dioxide is deposited in the lungs. (d) Oxygen-rich blood is pumped from the lungs, through the heart, then to the body. |
| 2 | 2b | D | (a) Oxygen-poor blood comes from the body to the heart. (b) Once acquired in the lungs, oxygen-rich blood returns to the heart before being pumped into the body. (c) Oxygen-poor blood passes from the body and through the heart before going to the lungs. (d) This answer is correct. |

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 Grade 5 science content standard (2b).

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 may want to develop rubrics to assist in the scoring of student work. The LAUSD Generic Scoring Guide for Written Products: Science (see Assessment Section of Rationale) may be helpful in the development of these rubrics.

Question 3: Draw a diagram of the human heart and label its parts. Explain the role of each chamber and how blood moves through the heart.

The students' response should include the following:

- The diagram should show:
 - the following chambers: right and left atrium; right and left ventricle
 - valves between atrium and ventricles on each side
 - wall between left and right sides of the heart
 - the pathway from body into heart; between heart and lungs; from heart to body
- The explanation should show:



- the role of each chamber of the heart
- the pathway of blood through the heart (oxygen poor blood comes from the body to the right atrium; to the right ventricle; to the lungs; blood gains oxygen; leaves the lungs; to the left atrium; to the left ventricle; to the body)

Question 4: Describe how the respiratory and circulatory systems work together to provide the body with oxygen and remove carbon dioxide waste.

The students' response should include the following:

- Oxygen enters the lungs by inhalation; carbon dioxide leaves the body by exhalation
- Oxygen and carbon dioxide are exchanged in the lungs and carried through the body in blood vessels.

Sample Items

Investigation and Experimentation (I&E)

Multiple Choice

These examples are designed to assess students' knowledge of standard 6.d. "Identify the dependent and controlled variables in an investigation." The examples show a range of difficulty and can be used to give students practice in responding to rigorous multiple choice questions.

5. In an experiment to determine how plants use leaves, three similar plants were used. One kept all its leaves, one had half its leaves removed, and one had all its leaves removed. Each day the height of the plants was recorded. The height of the plant is ___**B**
- A. the controlled variable.
 - B. the dependent variable.
 - C. the conclusion.
 - D. the inference.

6. A student wants to test for the presence of carbon dioxide as the by-product of cellular respiration. The student puts a freshwater plant in a solution of water and BTB (a carbon dioxide indicator), seals the container and puts the container in a dark place. Another container of BTB solution is sealed and put in a dark place. The controlled variables are ___**D**

- A. the plant and BTB solution.
- B. the dark place and the student.
- C. the student and the plant.
- D. the BTB solution and the dark place.

Question #5 requires that students correctly identify that the experiment is looking for a change in the plant as a result of the presence or absence of leaves. The ability for the plant to grow is impacted by the presence of leaves, so the height of the plant is the dependent variable in the experiment.

Question #6 asks students to carefully reflect on the experimental design provided. Students should know that controlled variables are the factors within the experiment that are kept the same. The BTB solution and the dark space are kept the same for the purpose of this experiment. The only difference is the plant in one of the containers. The student is not a part of the experiment.

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 | 6d | B | (a) The plants are the controlled variables. (b) This statement is correct. (c) The conclusion would be made based on analysis of the measurement data. (d) An inference would be made as to why the height of the plants differs as a result of the experiment. |
| 6 | 6d | D | (a) The BTB solution is a controlled variable but the plant is not. (b) The dark place is a controlled variable but the student is not. (c) Neither are controlled variables. (d) This statement is correct. |

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 (6f) as well as provide a context from the discipline standards.

Question 7: Explain the difference between a dependent variable and a controlled variable. Explain how these are used to answer scientific questions in an experiment.

The students' response should include the following:

- The dependent variable is where one expects a change (positive or negative) to occur as a result of the experiment.
- The controlled variable is what is being held constant for the purpose of the investigation.
- Through experiments, data is collected on dependent variables as evidence to answer scientific questions.

Question 8: A student wants to test for the presence of carbon dioxide as the by-product of cellular respiration. The student puts a freshwater plant in a solution of water and BTB (a carbon dioxide indicator), seals the container and puts the container in a dark place. Another container of BTB solution is sealed and also put in a dark place. The student examines the two containers for a color change every hour. After 4 hours the solution with the plant in it begins turning from blue to clear.

Identify the controlled and dependent variables in this experiment. Explain how this experimental design allows the student to determine whether cellular respiration occurs in plants when there is no light.

The students' response should include the following:

- The controlled variables are the BTB solution and the dark place.
- The dependent variable is the plant.
- With two containers of BTB solution (a carbon dioxide indicator), the student can compare the two solutions. Since the solution with the plant changed color and the other did not, the student can conclude that the plant generated the carbon dioxide and no other factor in the experiment did.



Plant Structures Unit

The *Plant Structures* unit allows students the opportunity

to deepen their understanding of how a plant transports materials internally through specialized structures, and how a plant performs the functions of photosynthesis and cellular respiration.

The *Immersion Unit* provides a structure to examine the parts of the plant and how each structure assists in the plant's survival. This is the first time for students to look inside an organism to determine how specific functions are completed. Finding ways to make this experience concrete will be helpful as students learn to visualize the inside of organisms at work.

Across Los Angeles there are many resources to support an enriched study of plants. The city's botanical gardens, museums and environmental organizations, among others, have a wide variety of resources, curriculum, and field trip opportunities that focus on how to better understand plants and how different plants solve the same survival challenges. 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 2a, 2e, 2f and 2g, with significant support for building science process skills in the I&E standards 6a – 6i.

California Academic Content Standards:

- 2a. *Students know* many multicellular organisms have specialized structures to support the transport of materials.
- 2e. *Students know* how sugar, water, and minerals are transported in a vascular plant.
- 2f. *Students know* plants use carbon dioxide (CO₂) and

energy from sunlight to build molecules of sugar and release oxygen.

- 2g. *Students know* plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO₂) and water (respiration).
- 6a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
- 6b. Develop a testable question.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6d. Identify the dependent and controlled variables 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.
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- 6h. Draw conclusions from scientific evidence and indicate whether further 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.

Vocabulary – The core vocabulary for the *Plant Structures* unit focuses on the parts of the plant involved in transport of materials and photosynthesis. Additional vocabulary reflects terminology students may have been introduced to in earlier

Grade 5 Life Science-Plant Structures

Los Angeles Unified School District



grades, and terms that they will become familiar with as a result of activities and research. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons – The additional lesson for this unit is: *Photosynthesis or Respiration, What’s the Equation?*.

Critical Questions

- What is the difference between photosynthesis and cellular respiration and what conditions are necessary for a plant to perform them?
- How does a plant transport materials internally to support its survival and what structures does it use?



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. Knowing the Greek or Latin derivation of these terms can be helpful.

Mathematics: In examining the equation for photosynthesis and cellular respiration, students will notice the balance of atoms in the equation. Teachers can relate this balancing of equations in science to the same principle in mathematics.

History - Social Science: If students have completed the Earth Science module, they may be interested in how scientists grow plants in space, and whether the different conditions affect the plants growth and survival. Students might become interested in reading about genetic engineering and how plants are bioengineered to grow faster, larger, or survive under less ideal conditions.

Health: Since we can derive energy from eating meat (other animals), students might want to explore why humans also need to eat plants (vegetables and fruits) and how this balanced diet increases our well-being and personal health.

Visual and Performing Arts: Many images created by botanists that show the internal structure of plants have been regarded as quality artistic renderings. Students might like to examine such artworks at museums, in books or through electronic resources. In addition, students can visualize and create artwork that depicts the path of nutrients through a plant.

Background

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

- All organisms have requirements for survival. A requirement is something an organism needs for survival, such as water and carbon dioxide for plants and oxygen and sugar for animals. Organisms use these requirements to build tissue for growth and generate energy for survival. As a result of making and storing usable energy, waste products result. A waste product is something an organism does not need for survival. For example, oxygen is a waste product for plants performing photosynthesis, and carbon dioxide is a waste product for animals.
- Some common misconceptions are that cellular respiration occurs only in animals between the respiratory and circulatory systems. In fact, cellular respiration is the process of cells using oxygen to assist in converting sugar into energy. The misconception comes from the similar words (respiratory system vs. cellular respiration). Cellular respiration occurs in every cell in an organism, thereby the term cellular.



“There are no foolish questions, and no man becomes a fool until he has stopped asking questions.”

- Charles Proteus Steinmetz



Grade 5 Vocabulary Plant Structures

Core

carbon dioxide (CO_2)
 cells
 cellular respiration
 chemical reaction
 compound
 multicellular organisms
 oxygen (O_2)
 phloem
 photosynthesis
 respiration
 sugar ($C_6H_{12}O_6$)
 vacuole
 vascular plant
 veins
 xylem

Additional

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

Investigation & Experimentation

criteria
 data
 dependent variable
 evidence
 independent variable
 infer
 quantitative

Grade 5

Investigation & Experimentation

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

Grade 4





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California Academic Content Standards:

- 2a. *Students know* many multicellular organisms have specialized structures to support the transport of materials.
- 2e. *Students know* how sugar, water, and minerals are transported in a vascular plant.
- 2f. *Students know* plants use carbon dioxide (CO₂) and energy from sunlight to build molecules of sugar and release oxygen.
- 2g. *Students know* plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO₂) and water (respiration).
- 6a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
- 6b. Develop a testable question.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6d. Identify the dependent and controlled variables 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.
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- 6h. Draw conclusions from scientific evidence and indicate whether further 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.

|  | HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | |  |
|---|---|--|---|--|---|
| | RESOURCE | NOTES | RESOURCES | NOTES | |
| | Chapter 1 <ul style="list-style-type: none"> • Lesson 1, <i>What are Cells, and What Do They Do?</i> pg A4-13 • WB 4 | <ul style="list-style-type: none"> • <i>Observing Cells</i>, pg. A4-5, an introduction to cellular structure • Emphasize organisms are made of cells and cells have specialized structures to support the transport of materials | Cells FOSS: Food and Nutrition, <u>Science Stories</u> <ul style="list-style-type: none"> • <i>Living Cells</i>, pg. 41-43 • Investigation 4, Page 21 | <ul style="list-style-type: none"> • Includes equations for photosynthesis and cellular respiration | |







HARCOURT SCIENCE TEXTBOOK

SUPPLEMENTAL
* Resources are organized by topic



| RESOURCE | NOTES | RESOURCES | NOTES |
|--|---|---|-------|
| <ul style="list-style-type: none"> • Science Through Time: <i>Discovering Cells</i>, pg. A28-29 <p style="text-align: center;">Chapter 2</p> <p>Lesson 1</p> <ul style="list-style-type: none"> • WB 18 • WB 19 <ul style="list-style-type: none"> • Lesson 3, <i>How Are Plants Classified?</i>, pg. A48 – 53 • WB 26 <p style="text-align: center;">Chapter 3</p> <ul style="list-style-type: none"> • Lesson 1, <i>What Are the Functions of Roots, Stems, and Leaves?</i> pg. A62 – 69 • WB 30-31 • Investigation Challenge, p. A66 • Lesson 2, <i>How Plants Use Carbon Dioxide</i>, pg. A70-71 • WB 34 – 35 • A3-2 • Water in Plants, p. A95 | <ul style="list-style-type: none"> • Identifying parts of cells provides a foundation for Grade 7: 1a, 1b, 1d • Classification as a system. <ul style="list-style-type: none"> • <i>Plant Stems</i>, pg. A48-49 may take longer than estimated time • Emphasize vascular plants • Emphasize xylem and phloem. <ul style="list-style-type: none"> • Photosynthesis versus cellular respiration | <p style="text-align: center;">Plants</p> <p>McGraw Hill</p> <ul style="list-style-type: none"> • <i>Plants</i>, pg. 16 • <i>Study Aid 3</i>, p. 29 - 31 | |



|  | HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | |  |
|---|---|--|--|-------|---|
| | RESOURCE | NOTES | RESOURCES | NOTES | |
| | <p>Chapter 4</p> <ul style="list-style-type: none"> • Lesson 1, <i>How Do Plants Make Food?</i> pg. A100 - 107 • WB 48 - 49 • WB 50 • WB 37 • Investigation Challenge, p. A106 <p>Activities for Home or School</p> <ul style="list-style-type: none"> • <i>Leaf Casts</i>, p. 131 • <i>Making Food</i>, p. 132 | <ul style="list-style-type: none"> • Structures for transport of materials • Focus on role of leaf | | | |

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 |
|----------|--|--|
| | <ul style="list-style-type: none"> • Photosynthesis or Respiration, What's the Equation? pg. 75 | <ul style="list-style-type: none"> • Students practice the equations for photosynthesis and respiration, connected to their physical science studies. |



| S | Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | | | | Notes |
|---|--|--|--------|----------------------------------|-------|-------|-------|-------|-------|-------|-------|----|----|----|----|----|----|----|----|---|---|
| | | | | PS 1a | PS 1b | PS 1f | PS 1g | LS 2a | LS 2e | LS 2f | LS 2g | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | 6i | |
| t a n d a r d s A l i g n m e n t | FOSS: Food & Nutrition | Science Stories: <i>Living Cells</i> | 41-43 | | | | | ▼ | ▼ | ▼ | ▼ | | | | | | | | | | Provides the equations for photosynthesis and cellular respiration. |
| | Harcourt, Chapter 1, Lesson 1 | Observing Cells | A 4-5 | | | | | ▼ | | | | | | | | | | | | | Students examine prepared slides as an introduction to cell structure. |
| | | The Inside Story: <i>Comparing Plant and Animal Cells</i> | A 8-9 | | | | | ▼ | | | | | | | | | | | | | Image of the vacuole is the only structure identified for transport in diagrams |
| | | Process Skills Practice: <i>Observe and Infer</i> | WB 4 | | | | | | | | | ▼ | | | | | | | | | |
| | Harcourt, Chapter 1 | Science Through Time: <i>Discovering Cells</i> | A28-29 | | | | | ▼ | | | | | | | | | | | | | Text on the discovery of cells, germs, vaccines and antibiotics |
| Harcourt, Chapter 2, Lesson 1 | Process Skills practice: <i>Classify</i> | WB 18 | | | | | | | | | ▼ | | | | | | | | | Practice classifying objects by physical attributes | |
| | Lesson Concept Review: <i>How Do Scientists Classify Living Things?</i> | WB 19 | | | | | | | | | ▼ | | | | | | | | | Classification using kingdoms | |

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



| S | Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | | | Notes | | |
|---|-------------------------------|---|----------|----------------------------------|-------|-------|-------|-------|-------|-------|-------|----|----|----|----|----|----|----|----|-------|--|--|
| | | | | PS 1a | PS 1b | PS 1f | PS 1g | LS 2a | LS 2e | LS 2f | LS 2g | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i | |
| t a n d a r d s | Harcourt, Chapter 2, Lesson 3 | Plant Stems | A 48-49 | | | | | | ▼ | | | | | | | | | ▼ | ▼ | ▼ | This activity may take more than 1 hour to see the food coloring move up the stem. | |
| | | Process Skills Practice: <i>Infer</i> | WB 26 | | | | | | | | | | | | | | | | ▼ | | | To infer from observations |
| | | Plant Classification | A50 – 51 | | | | | | | ▼ | | | | | | | | | | | | The distinction between vascular and non-vascular plants |
| A l i g n m e n t | Harcourt, Chapter 2 | Science Through Time: <i>Naming Living Things</i> | A 54-55 | | | | | | | | | | ▼ | | | | | | | | History of classification | |
| | Harcourt, Chapter 3, Lesson 1 | The Parts of a Vascular Plant | A60-61 | | | | | | | ▼ | | | | | | | | | | | | |
| | | Investigate Log | WB 30-31 | | | | | | ▼ | | | | | | | | | | | | To be used with activity, <i>Parts of a Vascular Plant</i> . | |
| | | The Parts of a Vascular Plant | A62-63 | | | | | | ▼ | ▼ | | | | | | | | | | | Focus on structures in plant | |
| | | What Vascular Plant Parts Do | A64 – 69 | | | | | | | ▼ | | | | | | | | | | | | |
| Investigation Challenge: <i>Observing Water Movement in Stems</i> | | A66 | | | | | | | ▼ | | | | | | | | | ▼ | ▼ | ▼ | | |

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 1b | PS 1f | PS 1g | LS 2a | LS 2e | LS 2f | LS 2g | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | 6i | | |
| Harcourt, Chapter 3, Lesson 2 | How Plants Use Carbon Dioxide | A70-71 | | | | | | | ▼ | | | | | | ▼ | ▼ | ▼ | ▼ | ▼ | | This activity requires BTB or another CO ₂ indicator. |
| | Investigate Log | WB 34-35 | | | | | | | ▼ | | | | | | | | | | | | To be used with activity, <i>How Plants Use Carbon Dioxide</i> . |
| | Process Skill Tip: <i>Observe and Infer Transparency</i> | A3-2 | | | | | | | ▼ | ▼ | | | | | ▼ | | | | | | Students make inferences on whether photosynthesis or cellular respiration occurred. Students need to know the effects of a BTB test. |
| Harcourt, Chapter 3 | Activities for Home or School: <i>Water in Plants</i> | A95 | | | | | | ▼ | | | | | | | | | | | | | A model of capillary action |
| Harcourt, Chapter 4, Lesson 1 | How Plants Use Leaves | A100-101 | | | | | | | ▼ | | | | | | ▼ | ▼ | | ▼ | ▼ | | An activity in which students measure the heights of plants after removing leaves. Many plants are required. |
| | Investigate Log | WB 48-49 | | | | | | | ▼ | | | | | | ▼ | | ▼ | ▼ | | | To be used with activity, <i>How Plants Use Leaves</i> |
| | How Plants Make Food | A102-107 | | | | | | | ▼ | | | | | | | | | | | | Text - Focus on the process of photosynthesis |
| | Food Energy | A106 | | | | | | | | ▼ | | | | | | | | | | | |

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



| S | Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | | | Notes | | |
|---|---|--|------------------------|----------------------------------|-------|-------|-------|-------|-------|-------|-------|----|----|----|----|----|----|----|----|-------|--|--|
| | | | | PS 1a | PS 1b | PS 1f | PS 1g | LS 2a | LS 2e | LS 2f | LS 2g | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i | |
| t a n d a r d s A l i g n m e n t | | Investigation Challenge: <i>Testing Plant Parts for Starch</i> | A106 | | | ▼ | | | | | | | | | | | | | | | Students can develop their own tests for the presence for starch. If they write a report, the work is aligned with 6i. | |
| | Harcourt, Chapter 4 | Activities for Home or School: <i>Leaf Casts</i> | A131 | | | | | ▼ | | | | | | | | | | | | | | Observing structures for transport of materials (stomata) |
| | | Activities for Home or School: <i>Making Food</i> | A 132 | | | | | | | ▼ | | | | | | | | | | | | |
| | Additional Lesson in this Guide to support the Harcourt Program | Photosynthesis or Respiration, What's the Equation? | <i>Guide</i> , page 75 | ▼ | ▼ | | ▼ | | | ▼ | ▼ | | | | | | | | | | | Students practice the equations for photosynthesis and respiration, connected to their physical science studies. |
| | McGraw Hill | Plant Survival | 16 | | | | | ▼ | ▼ | | | | | | | | | | | | | |
| Study Aid 3: <i>Making Food: Photosynthesis</i> | | 29, 31 | | | | | | | ▼ | | | | | | | | | | | | | A diagram of the process of photosynthesis and questions for student discussion |

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.

Photosynthesis or Respiration - What's the Equation?

Science Standards

Life Science:

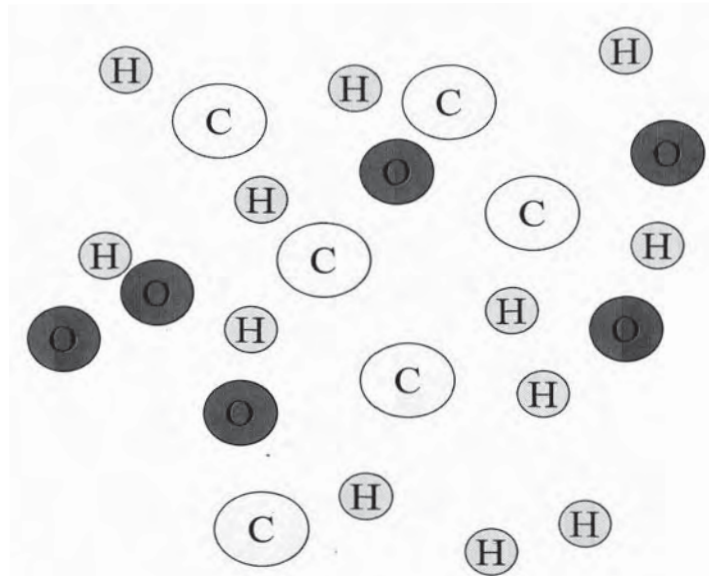
- 2f. Students know plants use carbon dioxide (CO₂) and energy from sunlight to build molecules of sugar and release oxygen.
- 2g. Students know plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO₂) and water (respiration).

Connections to Physical Science:

- 1a. Students know that during chemical reactions the atoms in the reactants rearrange to form products with different properties.
- 1b. Students know all matter is made of atoms, which may combine to form molecules.
- 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.
- 1h. Students know living organisms and most materials are composed of just a few elements.

Focus Concepts

- The equation for photosynthesis is $(6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2)$. Energy for the reaction is provided by the Sun.
- The equation for cellular respiration is $(\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O})$. This reaction produces energy that both plants and animals need for survival.



Purpose

Students will have hands-on experience manipulating the atoms into molecules and rearranging these combinations to illustrate the equations of photosynthesis and cellular respiration.

Background

The physical science standards ask that students know that atoms combine to form molecules, and that these molecules may have different properties than the elements that made them. Students should be familiar with a variety of simple molecules and their symbolic representations.

This activity allows students a tactile experience to combine and rearrange atoms to form simple molecules. The example provided here shows the relationship (at an equation level) between photosynthesis and cellular respiration. Students might make connections to their work in mathematics on balancing





equations. Students can do this activity before or after they have studied the physical science module.

Preparation

Prepare items to symbolize the different elements. Colored math manipulatives or a variety of candy work well. In this description, the following types of candy are used:

- Raisins for oxygen
- Gummy bears for carbon
- Mini-marshmallows for hydrogen

Students can bring in supplies or determine the manipulatives to depict each element if preferred.

You might want to prepare bags with enough of each candy for students to build their models. Otherwise, students can collect their supplies from a central location as needed.

Procedures

(time to teach: 30 – 45 minutes)



Students will need: (for each pair)

Student recording sheet
Bag of candy / manipulatives
toothpicks

1. Students may want to wash their hands and do this work on a paper towel so they can eat the candy when they are done.
2. Discuss with students how everything is made of atoms, from the largest building to the smallest animal. The word *atom* means “the smallest that cannot be divided” in Latin. Although we can split atoms, the smallest substance that maintains the characteristics of the element is the atom.

Sometimes atoms of the same element combine to form molecules, and sometimes atoms of different elements combine to form molecules of compounds such as water. A molecule is the smallest particle of a compound, as an atom is the smallest particle of an element. Scientists have discovered how many of each kind of elements’ atoms are needed to make common molecules – like a recipe.

3. Hand out the student sheet. Discuss how the student sheet shows the symbolic representation, or formula, for some common molecules. Remind students that the letters represent the kind of atom (they can look on the Periodic Table to identify what each symbol stands for) and the small numbers after the letter tell them how many of the atom is in that molecule. Using the materials in their bag and the toothpicks, in teams, have students build the first set of molecules (water and carbon dioxide). Check the teams’ work.
4. When students have completed their models, have them return any extra manipulatives.
5. Next, explain to students that when carbon dioxide and water are in the presence of chlorophyll and sunlight, plants are able to break the bonds (the toothpicks) and rearrange the atoms to make sugar.
6. Have students create the glucose molecule using the same manipulatives that they used to make the water and carbon dioxide. When they are finished, ask what is left over (12 oxygen atoms).
7. Oxygen is commonly found in pairs of 2. What do you think the plant does with the oxygen that is left over from making sugar? (they release it into the air and we’re able to breathe it)



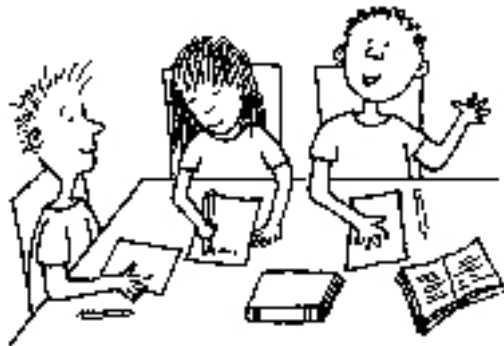


This sample instructional activity illustrates possible strategies for accessing the content within the standards.

- When plants need energy, do you think they can reverse this process? [*yes, it's called cellular respiration. In the presence of oxygen but in the absence of light, plants break the bonds of the sugar for energy and the atoms rearrange into carbon dioxide and water - just like animals do*]
- Based on this experience, ask students to generate the equations for photosynthesis and cellular respiration.
- Discuss with students how the very few “building blocks” of carbon, oxygen, hydrogen, nitrogen, sulfur and phosphorus are combined and rearranged in multiple ways resulting in the wide variety of life on Earth.

Discussion Starters

- Describe chemical notation (i.e. H_2O): what do the letters (atomic symbols) and numbers represent?
- Why do scientists create models to show how processes work? How does the model created in this activity help you better understand the equations for photosynthesis and cellular respiration?
- How are photosynthesis and cellular respiration in plants similar?



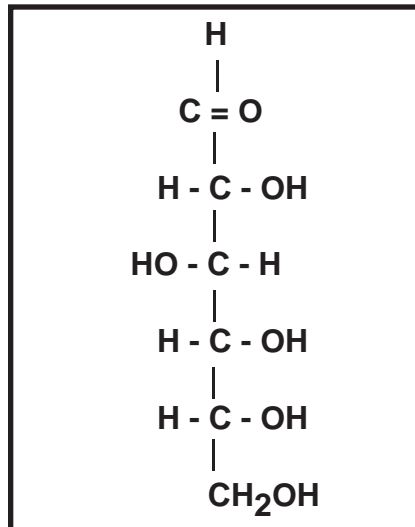
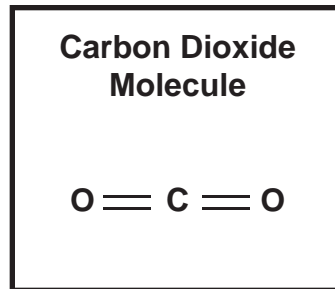
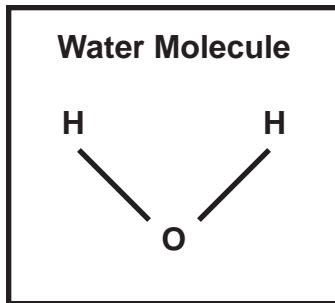
Name: _____

Photosynthesis or Respiration - What's the Equation?

You will need:

- Bag of manipulatives
- Toothpicks

Build 6 models of each of the following (the lines represent the connection between the atoms. You will use toothpicks to show these connections):



Imagine that a great source of energy (Sunlight) enters the system and breaks all the connections between your atoms. These atoms now get mixed up. Use these same manipulatives to make a sugar molecule.

After making the sugar molecule, what manipulatives were left over?

What did these manipulatives represent?

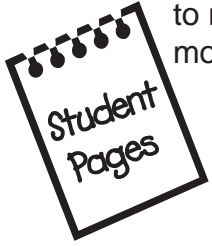
In this process, were any atoms lost or unused?

Your model went through three stages:
Stage 1: hydrogen, oxygen and carbon atoms
Stage 2: the atoms arranged into the molecules of water and carbon dioxide
Stage 3: the atoms rearranged into sugar and oxygen.

What were the properties of each molecule at each stage?

Based on this experience, what is the equation for photosynthesis?

What is the equation for cellular respiration?





Animal Structures Unit

The Animal Structures unit allows students the opportunity to deepen their understanding of animals' specialized structures to transport nutrients, digest food, and remove waste products. Although scientists put these structures into systems (digestive, respiratory, excretory, circulatory), an organ may be in more than one system by the nature of the work it performs. For example, the lungs can be considered a part of the respiratory and excretory systems.

The Immersion Unit for this module provides a structure to examine specific parts of an animal and how the structures identified assist in the organism's survival. This is the first time for students to look inside an animal to determine how specific functions are completed. Finding ways to make this experience concrete will be helpful as students learn to visualize the inside of organisms at work. Computer simulations, videos, and reference illustrations may be available through your school or public library.

Across Los Angeles there are many resources to support an enriched study of animals. The city's museums, zoos, and environmental organizations, among others, have a wide variety of resources, curriculum, and field trip opportunities that focus on how to better understand animals and how different animals solve the same survival challenges. 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 2b – 2d, with significant support for building science process skills in the I&E standards 6b, 6c and 6i.

California Academic Content Standards:

- 2b. *Students know* how blood circulates through the heart chambers, lungs, and body and how carbon dioxide (CO₂) and oxygen (O₂) are exchanged in the lungs and tissues.
- 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.
- 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.
- 6b. Develop a testable question.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6i. Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions.

Vocabulary –The core vocabulary for the *Animal Structures* unit focuses on the parts of an animal involved in transport of materials, digestion, and removal of cellular waste. Additional vocabulary reflects terminology students may have been introduced to in earlier grades, and terms that they will become familiar with as a result of activities and research. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons – The additional lessons for this unit are: *Waste Removal in Plants and Animals*, and *The Digestive System*.





Critical Questions

- Describe the path blood follows in order to remove carbon dioxide and replenish oxygen to the body's cells.
- What are the sequential steps of digestion and the roles of each organ in the process?
- How does the body remove cellular waste? What organs are involved?

ASK A QUESTION ASK A QUESTION
QUESTIONS?



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 may find it helpful to visualize the sequential steps of digestion, circulation, and cellular respiration. Building poems, short stories, or explanatory essays can support existing language arts goals for descriptive and explicit language.

Mathematics: Students may read charts or graphs on rates of respiration, digestion, or waste removal. Practice reading graphs and charts for information is a basic skill from which students can develop a keen ability to create charts and graphs from experimental data.

Health: The study of digestion and respiration connects meaningfully to students' making healthy choices in areas such as exercise, nutrition, and tobacco use. Students may also research common ailments and treatments related to disfunctioning organs or systems such as asthma or obesity.

Background

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

- All organisms have requirements for survival. A *requirement* is something an organism needs for survival,

such as water and carbon dioxide for plants and oxygen and sugar for animals. Organisms use these requirements to build tissue for growth and generate energy for survival. As a result of making and storing usable energy, waste products result. A *waste product* is something an organism does not need for survival. For example, oxygen is a waste product for plants performing photosynthesis, and carbon dioxide is a waste product for animals.

- Some common misconceptions are that cellular respiration occurs only in animals between the respiratory and circulatory systems. In fact, cellular respiration is the process of cells using oxygen to assist in converting sugar into energy. The misconception comes from the similar words (respiratory system vs. cellular respiration). Cellular respiration occurs in every cell in an organism, thereby the term *cellular*. The standards ask that students understand the role of the kidney in waste removal. The kidney removes cellular waste from the blood once the blood has removed the waste from other cells in the body. This waste is stored in the bladder until it is removed from the body.
- Students need to know the sequential steps of digestion and the roles of teeth and the mouth, esophagus, stomach, small intestine, large intestine, and colon in the function of the digestive system. Students will learn about the role of enzymes and diffusion of nutrients in this process later in high school.
- Students may think that the solid waste that leaves the body is the result of cellular respiration. In fact, the solid waste is the result of food that is not absorbed by the body, primarily fibrous and other indigestible materials.

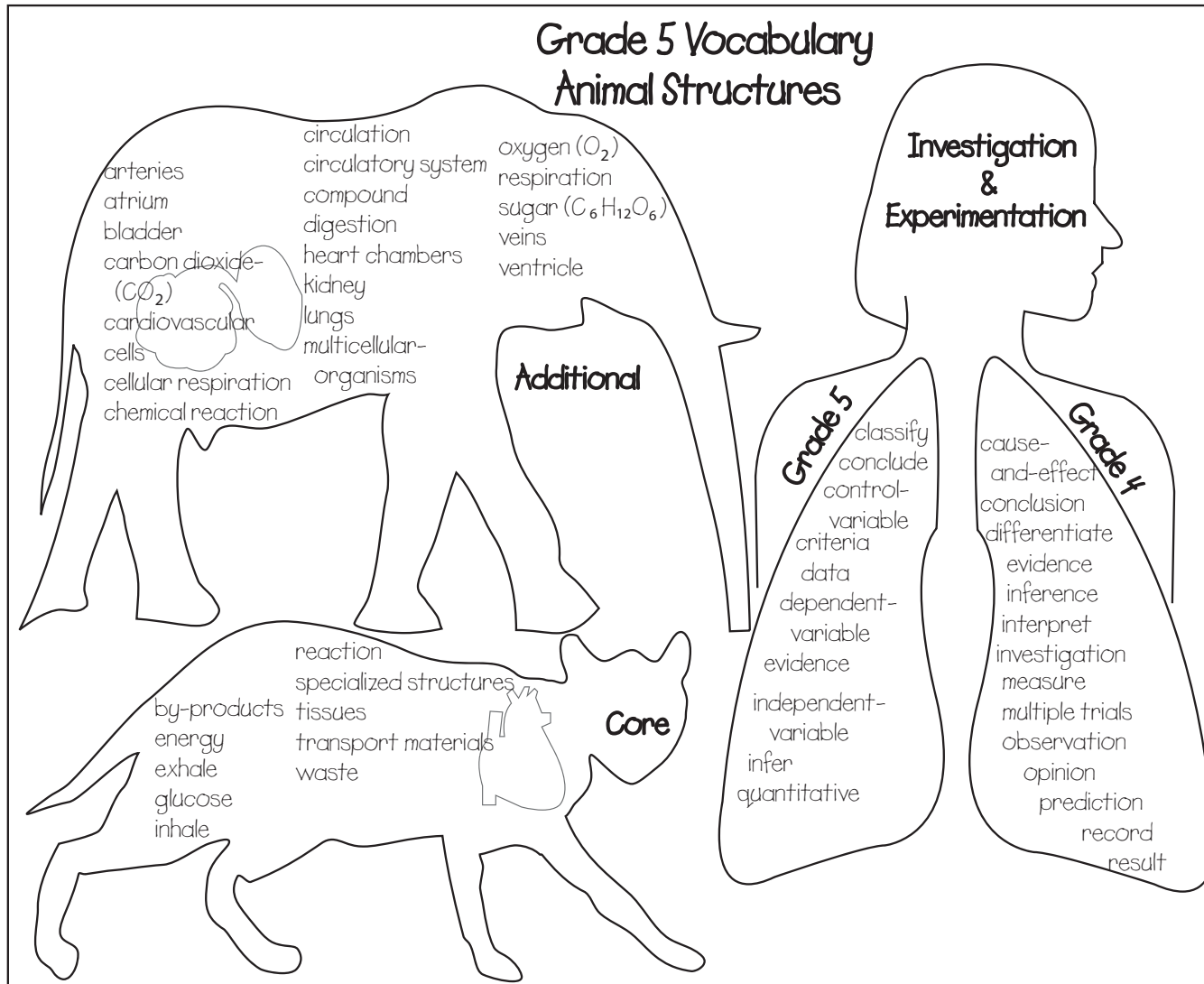


"Nature composes some of her loveliest poems for the microscope and the telescope."

- Theodore Roszak, *Where the Wasteland Ends* (1972)





Grade 5 Vocabulary Animal Structures



California Academic Content Standards:

- 2b. *Students know* how blood circulates through the heart chambers, lungs, and body and how carbon dioxide (CO₂) and oxygen (O₂) are exchanged in the lungs and tissues.
- 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.
- 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.
- 6b. Develop a testable question.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6i. Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions.

|  | HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | |  |
|---|--|---|---|--|---|
| | RESOURCE | NOTES | RESOURCES | NOTES | |
| | <p style="text-align: center;">Chapter 1</p> <ul style="list-style-type: none"> • Lesson 2, <i>How Do Body Systems Transport Materials?</i> pg A14 – 21 • WB 6-7 • Investigation Challenge: <i>Measuring Pulse Before and After Exercise</i>, p. A17 <p>Resource Pages</p> <ul style="list-style-type: none"> • R 32-33 • R 34-35 • R 36-37 | <ul style="list-style-type: none"> • Emphasize circulatory, digestive, and excretory systems <ul style="list-style-type: none"> • The Digestive System • The Circulatory System • The Respiratory System | <p style="text-align: center;">Circulatory System</p> <p>FOSS: Food and Nutrition, <u>Science Stories</u></p> <ul style="list-style-type: none"> • <i>Living Cells</i>, pg. 44-50 • <i>Blood That Fluid That Connects</i>, pg. 44 – 50 <p>Investigation 4, Pg. 21</p> <p>McGraw Hill: Human Body Pathways</p> <ul style="list-style-type: none"> • <i>Investigate How Blood Travels #1</i>, pg. 1-2 • <i>A Blood System</i>, Study Aid 1, p. 4 and 7 • <i>Squeeze Play</i>, p. 9 <p style="text-align: center;">Digestive System</p> <p>FOSS: Food and Nutrition, <u>Science Stories</u></p> <ul style="list-style-type: none"> • <i>Digestive System</i>, pg. 6-9 <p>Remedia Publications</p> <ul style="list-style-type: none"> • <i>The Digestive System</i>, pg. 2-4 | <ul style="list-style-type: none"> • Emphasize Kidney | |



| HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | |
|--|--|--|--|
| RESOURCE | NOTES | RESOURCES | NOTES |
| <p>If using the <i>Harcourt Science</i> 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 <i>Guide</i></p> | | | |
| MY NOTES | RESOURCES IN THIS GUIDE | | |
| | <ul style="list-style-type: none"> The Digestive System, pg. 87 Waste Removal in Plants and Animals, pg. 92 | <p style="text-align: center;">Excretory System</p> <p>McGraw Hill: Human Body Pathways</p> <ul style="list-style-type: none"> <i>Making a Model</i>, pg. 37-38 <p>Remedia Publications</p> <ul style="list-style-type: none"> <i>The Excretory System</i>, pg. 18 - 20 | |
| | <ul style="list-style-type: none"> Students learn the parts of the Digestive System and the role of each organ. Students test whether an organism can survive without removing cellular waste. | | <ul style="list-style-type: none"> Emphasize Kidney |



| Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | Notes | |
|-------------------------------|--|--------|----------------------------------|-------|-------|-------|-------|-------|-------|----|----|----|----|-------|--|
| | | | LS 2a | LS 2b | LS 2c | LS 2d | LS 2e | LS 2f | LS 2g | 6a | 6b | 6c | 6f | | 6i |
| FOSS: Food & Nutrition | Investigation 1 – Science Stories: The Digestive System | 6-8 | | | ▼ | | | | | | | | | | Expository Text and diagrams |
| | Investigation 4: <i>After the Story</i> | 21 | ▼ | | | | | | | | | | | | Provides questions for discussion after reading “Living Cells” Science Story |
| | Investigation 4 - Science Stories: <i>Living Cells</i> | 41-47 | ▼ | | | | ▼ | ▼ | ▼ | | | | | | Text - Includes the equations for photosynthesis and cellular respiration |
| | Investigation 4 – Science Stories: <i>Blood: The Fluid That Connects</i> | 44-47 | | ▼ | | | | | | | | | | | Expository Text |
| | Investigation 4 – Science Stories: <i>Cleaning the Blood</i> | 50 | | | | ▼ | | | | | | | | | Expository Text |
| Harcourt, Chapter 1, Lesson 2 | Cells and Tissues | A14-15 | ▼ | | | | | | | ▼ | | | ▼ | | An activity in which students observe prepared slides of human tissue. Focus on cell structures for transport of materials |
| | Investigate Log | WB 6-7 | ▼ | | | | | | | ▼ | | | ▼ | | To be used with <i>Cells and Tissue</i> activity, pg. A14-15. Focus on characteristics that distinguish types of tissue. |

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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|------------------------------------|---|---------------------------|----------------------------------|----------|----------|----------|----------|----------|----------|----|----|----|----|-------|----|---|
| | | | LS 2a | LS 2b | LS 2c | LS 2d | LS 2e | LS 2f | LS 2g | 6a | 6b | 6c | 6f | | 6i | |
| | Human body Systems: From Cells to Systems | A16 | ▼ | | | | | | | | | | | | | Text - Focus on cell structures for transport of materials |
| | Circulatory System | A 17 | | ▼ | | | | | | | | | | | | Diagrams and text on the system and function of major organs |
| | The Respiratory System | A18 | | ▼ | | | | | | | | | | | | Text - Focus on gas exchange within lungs. |
| | Digestive System | A 19 | | | ▼ | | | | | | | | | | | Diagrams of system and function of major organs |
| | Excretory System | A20-21 | | | | ▼ | | | | | | | | | | Text and diagrams - Focus on kidneys. Students will need additional support regarding prevention of cellular poisoning. |
| Harcourt, Chapter 1 | Respiratory System | R36-37 | | ▼ | | | | | | | | | | | | Text and diagrams of system and function of major organs |
| | Circulatory System | R34 - 35 | | ▼ | | | | | | | | | | | | Text and diagrams of system and function of major organs |
| | Digestive System | R32-33 | | | ▼ | | | | | | | | | | | Diagrams of the system, function of esophagus, stomach and salivary glands. |
| Additional Lesson in this Guide to | The Digestive System | <i>Guide</i> , page 87 | | | ▼ | | | | | | | | | | | Students learn the parts of the Digestive System and the role of each organ. |

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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| Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | Notes | | |
|---------------------------------------|--|------------------------|----------------------------------|----------|----------|----------|----------|----------|----------|----|----|----|----|-------|----|---|
| | | | LS 2a | LS 2b | LS 2c | LS 2d | LS 2e | LS 2f | LS 2g | 6a | 6b | 6c | 6f | | 6i | |
| Guide to support the Harcourt Program | Waste Removal in Plants and Animals | <i>Guide</i> , page 92 | | | | ▼ | | | | | ▼ | | ▼ | ▼ | ▼ | Students test whether an organism can survive without removing cellular waste. |
| McGraw Hill: Human Body Pathways | Activity 1: <i>Investigate How Blood Travels</i> | 1-2 | | ▼ | | | | | | | | | | | | An activity in which students investigate the path of blood |
| | Squeeze Play | 9 | | ▼ | | | | | | | | ▼ | ▼ | | | Students create a model of the heart and determine what makes it easy / difficult to “pump” |
| | Explore Activity: <i>How Blood Travels</i> | 2 | | | | | | | | | | | | | ▼ | Aligned if students complete responses or expand prompts to a report. |
| | Activity 1: <i>Making a Model</i> | 37-38 | | | | ▼ | | | | | | | | | | |
| | Study Aid 1: <i>A Blood System</i> | 4,7 | | ▼ | | | | | | | | | | | | Focus on the heart, its chambers and the direction of blood flow. |
| Remedia Publications: The Human Body | The Excretory System | 18-20 | | | | ▼ | | | | | | | | | | Focus on kidneys |
| | The Digestive System | 2-4 | | | ▼ | | | | | | | | | | | |

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.

The Digestive System

Science Standards

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.

Health Objectives

- Use correct terminology for body parts.
- Establish and maintain healthy eating practices

Focus Concepts

- 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.

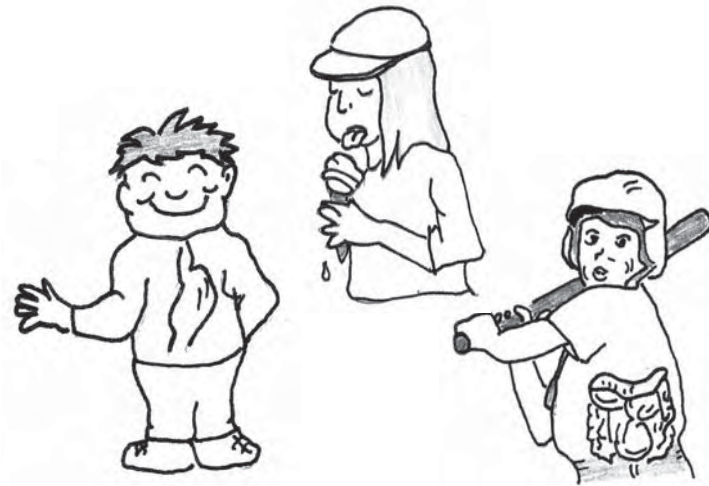
Purpose

Students will know the parts of the digestive system and the function of each organ.

Background

In Grade 5, students are expected to learn the organs that are a part of the digestive system and the role of each of these organs in the process of digestion. Students may be interested in digestive enzymes and their role, but this level of detail is not expected for mastery until high school (biology / life science standard 9f).

The *Harcourt Science* text provides background information on each organ and its function, although additional support for



student mastery may be required. The lesson below is provided as additional support.

Part 1 What is a system? (time to teach: 20 minutes)

Students will need: (for each group)

A large picture of a bicycle



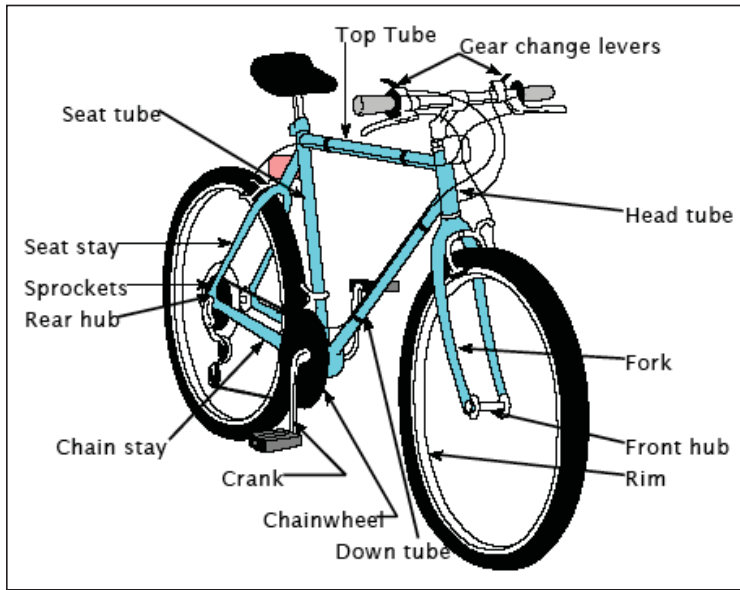
Procedures

1. Ask students what they know about what makes a system. Discuss how components working together to do a task may be defined as a system. Systems exist in many different places. Students can brainstorm types of systems (a school has systems in it, a cafeteria has systems to prepare food, a car has systems to make it operate, the body has systems to make it possible for people to survive).
2. Look at the picture of the bicycle. Examine the parts of the bicycle to determine the parts that make the bicycle operate.





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



Part 2 Where are the parts of the Digestive System located? (time to teach: 45 minutes)



Students will need: (for each group)
Butcher paper
Student "organ" sheets

Procedures

1. Return to the discussion in part 1 about what makes a system. Ask students what organs make up the digestive system. Students can look in the Harcourt Science textbook, pages A14-21 and R 32-33 to identify the organs that make up the digestive system.
2. In teams, students outline one student's body on the butcher paper (have one student lie down on the paper while others

outline their shape) and cut out the outline.

3. Students can attach their body forms to the wall, with the torso of their forms within easy reach.
4. Using the diagrams in their text and the outlines of body organs provided, have students draw the organs of the digestive system on their body outlines. These organs should be labeled.

Part 3

What do the parts of the Digestive System do? (time to teach: 45 minutes)

Students will need: (for each group)
Textbook and other resources



Procedures

1. Return to the diagram of the bicycle (part 1). Ask a student to come to the front of the classroom and show the movement of the pedal. The student can create a gesture with hands or with the whole body. The teacher can act as the "foot" causing the pedal to move.
2. Ask a second student to come up to the front of the classroom and demonstrate what the chainwheel (round disk with teeth that the pedals are attached to) does. Have the two students stand next to each other so that as the "foot" pushes the pedal, and the pedal causes the chainwheel to move.
3. Continue to have students come up to the front of the room, each representing a fundamental piece of the system that makes the bicycle move, with a gesture or movement that represents the function of each component.





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

4. Ask students to get back into their cooperative groups from part 2. In these groups, students should represent each organ of the digestive system through gestures or movements that reflect the *function* of that organ, as was just modeled with the bicycle.
5. Have teams of students share their “digestion machines” and discuss how each one shows the role of each organ:
 - a. the teeth in the mouth break food into smaller pieces
 - b. the esophagus moves food from the mouth into the stomach
 - c. the stomach mixes food
 - d. absorption of nutrients in the small intestine
 - e. absorption of excess water in the large intestine and colon
 - f. solid waste (undigestible food) is removed from the body through the colon

Extensions: There are a number of videos (check availability for check out at the district Math / Science / Technology Centers) that show the process of digestion. Some videos show the effect of eating specific foods such as potato chips on the esophagus and stomach.

To help students understand how the small intestine supports absorption, students may be interested in the organ’s physical characteristics. The small intestine is about 7 meters in length, and its surface has “bumps” called *villi* to increase its surface area for absorption. The villi look like the surface of a terry cloth towel. If the surface of the organ with each villus were stretched out flat, it would cover almost 250 square yards.

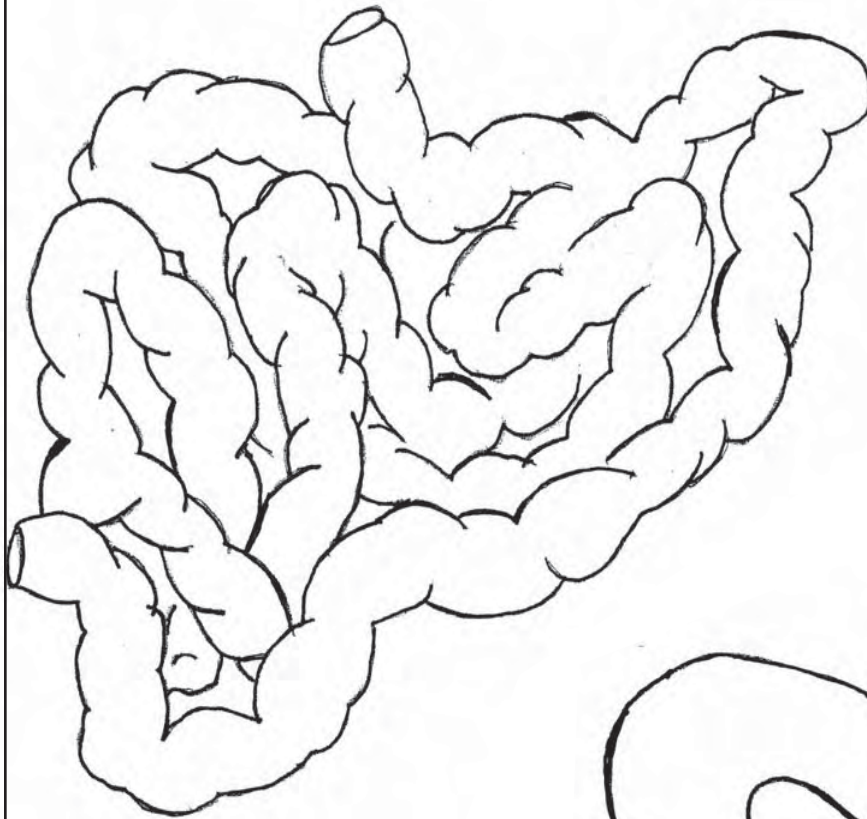
Sources Used in Developing This Lesson

Local District B, *5th Grade Life Science Resources for Teachers and Students*

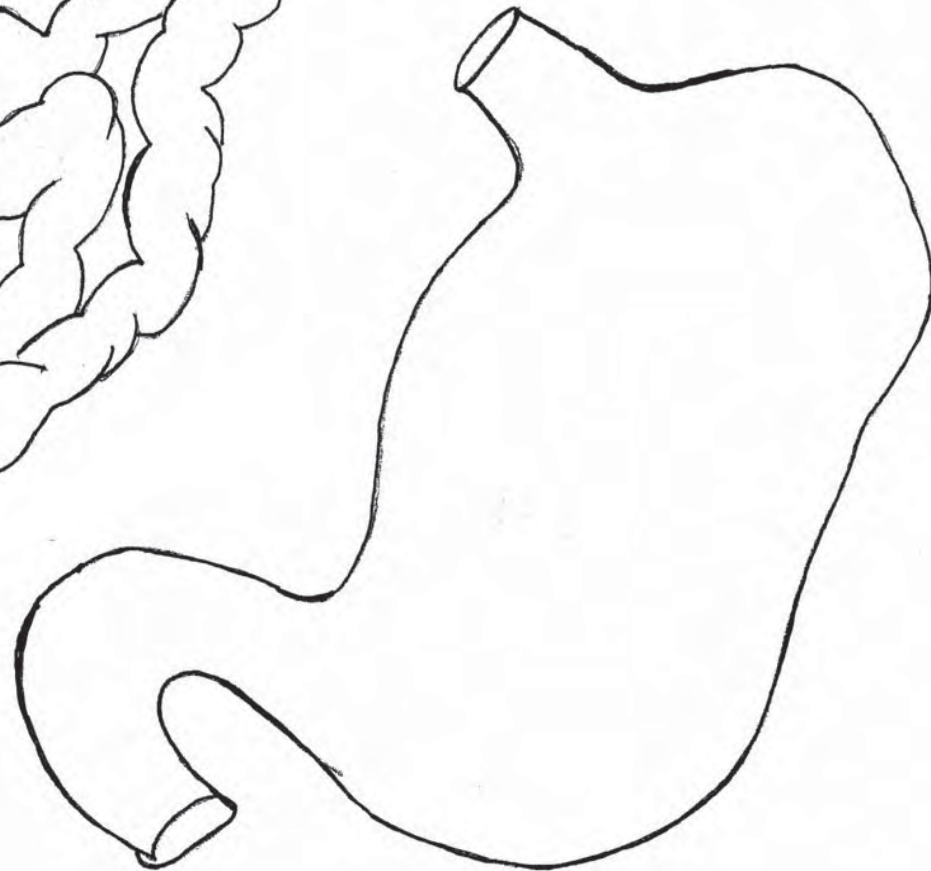
Graphics by the Saskatchewan Coalition on Bicycle Safety – *Bicycle Safety Education Resource Overheads*, <http://www.borealisortdoor.com/enhanced/can-bike/schools/PartsOfTheBike.pdf>.

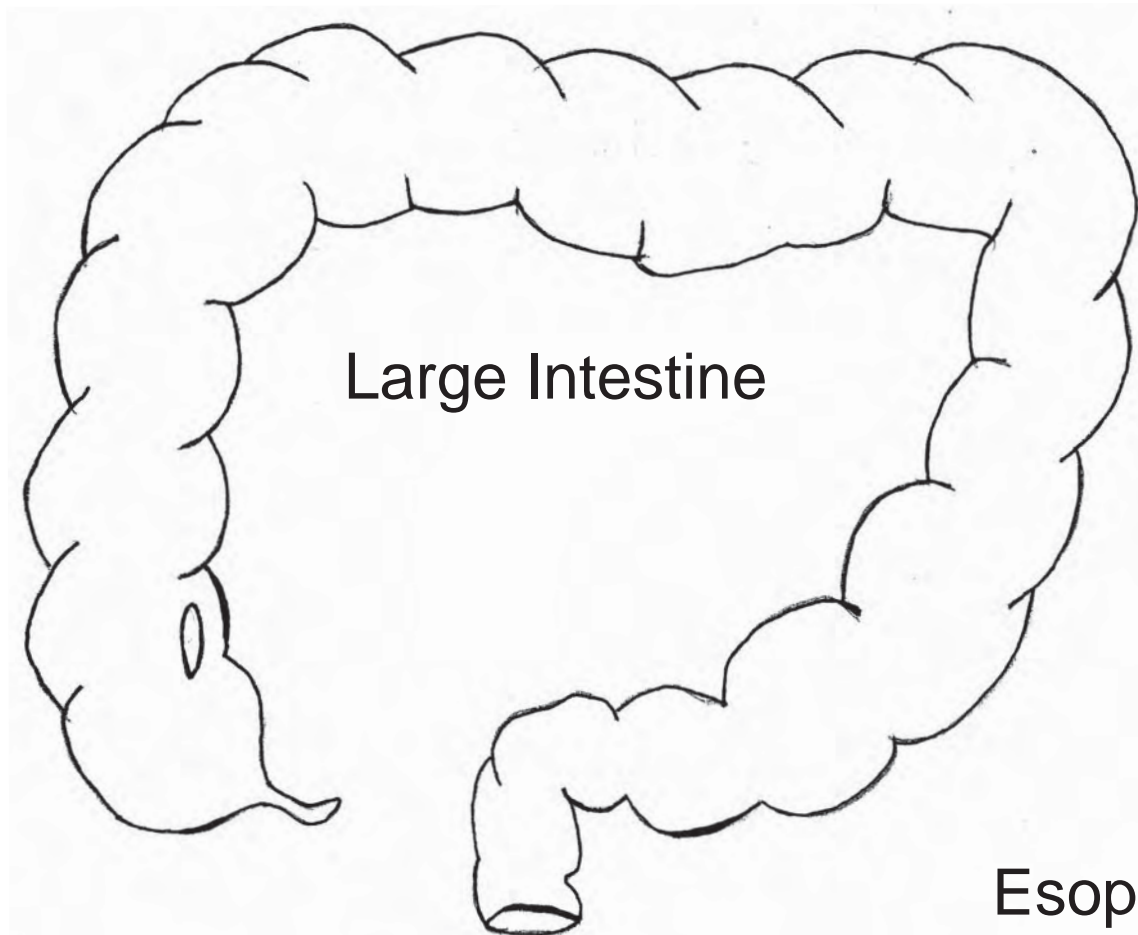


Small Intestine



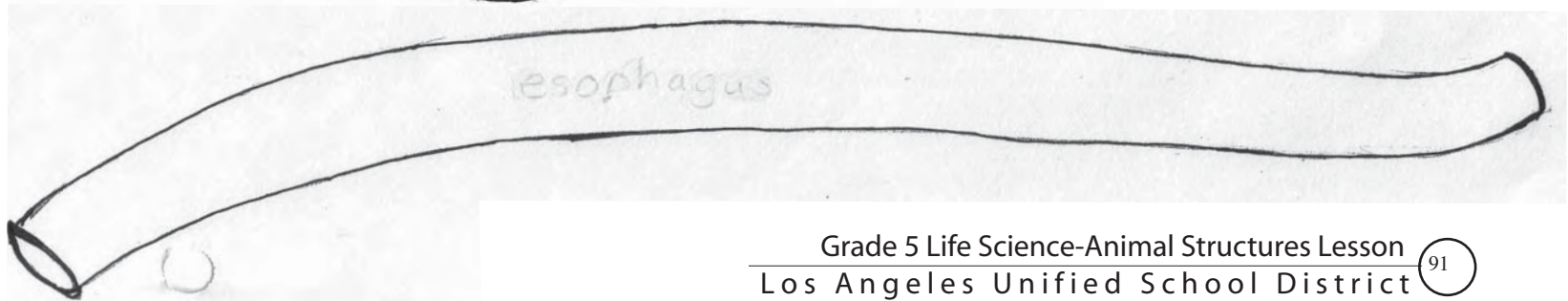
Stomach





Large Intestine

Esophagus





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

Waste Removal in Plants and Animals

Science Standards

- 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.
- 2g. *Students know* plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide (CO_2) and water (respiration).
- 6b. Develop a testable question.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6i. Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions.

Focus Concepts

- 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.

- The process of using sugar and oxygen to produce energy, for both plants and animals, is called cellular respiration.
- Students develop a question that can be tested through experimental means.
- Students plan a simple investigation based on a student-developed question.
- Students conduct a simple investigation based on a student-developed question.
- Students write procedures that can be carried out.
- Students make quantitative observations
- Students write a report of an investigation that includes sections on conducting tests, collecting data or examining evidence, and drawing conclusions.





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

Purpose

Students will understand that all living organisms need to remove waste in order to survive.

Background

All organisms have requirements for survival. A *requirement* is something an organism needs for survival, such as water and carbon dioxide for plants and oxygen and sugar for animals. Organisms use these requirements to build tissue for growth and generate energy for survival. As a result of making and storing usable energy, waste products result. A *waste product* is something an organism does not need for survival. For example, oxygen is a waste product for plants performing photosynthesis, and carbon dioxide is a waste product for animals.

A common misconception is that cellular respiration in animals occurs only between the respiratory and circulatory systems. In fact, cellular respiration is the process of cells using oxygen to assist in converting sugar into energy. The misconception comes from the similar words (respiratory system vs. cellular respiration). Cellular respiration occurs in every cell in the body, thereby the term *cellular*. The respiratory system exchanges oxygen for carbon dioxide within the blood.

Every cell in the body also generates other waste products besides carbon dioxide. In humans as well as many other animals, the kidney is the organ that removes many of these additional waste products from cellular respiration.



It is challenging to find interactive experiences for students to see the kidney at work, yet students can develop experiments to test what happens to a plant when it is unable to remove waste products. Through discussions comparing the effects on the plant with the role of the kidney, students can understand the role of the kidney in waste removal.

In addition, although plants do not have structures such as kidneys, many plants can store waste from cellular respiration in *vacuoles*, storage spaces within individual plant cells. This lesson is related to students' mastery of standards 2f and 2g and would be most powerful as a part of or following students' study of the processes of photosynthesis and cellular respiration in plants.

Experimental Design (time to teach: 30 minutes)

Part 1

1. Talk with students about cellular respiration and the relationship between cellular respiration in plants and animals (see *Background* for additional information).
2. Ask students what questions they could test to prove that plants remove waste. Brainstorm testable questions. *For example, students might ask if plants can survive if they cannot remove cellular waste from their leaves.*
3. Tell students that each of their cooperative work teams will be given a plant. In these teams, students should choose a question they want to test based on the brainstorm.
4. As a team, students should prepare a set of procedures for their experiment. *For example, students might propose to cover the leaves of a plant with Vaseline so that water and gases cannot enter or exit the plant through the leaves. Depending on the plant used, some may have stomata on the tops and bottoms of leaves for release of oxygen and water and for absorption of carbon dioxide, but other plants do not separate these functions. Check with the plant nursery for details if you'd like to limit these variables. Students would identify specific characteristics of the plant (height, number of leaves, color of leaves, etc.) to measure in order to determine if blocking the plant stomata has an effect on plant survival.*





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

This of course, is a simulation, since closing off the stomata of a plant will also prevent nutrients from entering the plant, so depending upon the plant, students may experiment with coating just the tops or bottoms of the leaves with Vaseline. Examination with a hand lens may allow students to see the stomata.

Part 2

Implementing the experiment (time to teach: 10 minutes twice a week)

Students will need: (for each group)



plant
other materials as determined by the experimental design (*for example, a ruler, color chart, and Vaseline for the example provided.*)

Procedures

1. Twice a week during the course of this study, (or more often if preferred) students take quantitative measurements of their plants, collecting data on the attributes of the plant.
2. While students are observing and collecting quantitative data on their plants, students may be studying about cellular respiration in animals. Students can create comparisons between the role of the vacuole in plants with the role of the kidney in animals.
3. Students graph their data and write a report of their procedures, results and conclusions. Conclusions should include the relationship between cellular respiration in plants and animals.



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

Developed based on design by Diana Roston, LAUSD teacher.

Module Planning Calendar

| 5 | Unit of Instruction: | Selected Resource(s): | Assessment: | 6 | Unit of Instruction: | Selected Resource(s): | Assesment: |
|------------------------|--------------------------------|-----------------------|-------------|------------------------|--------------------------------|-----------------------|------------|
| 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 | | | |

Developed based on design by Diana Roston, LAUSD teacher.

Grade 5 Earth Science

Introduction

In grade 5 Earth science, students study the water cycle, weather, and the solar system. Each may seem like a separate topic (and they can be taught separately), but these systems do interact with each other.

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 complexity 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 Kindergarten, students observe how water can change from a solid to a liquid and a gas (and back again). They notice changes in weather and how these changes affect people in the community. In Grade 1, students use simple tools to measure changes in weather. They learn that although there are daily changes in local weather, trends in temperature or rain (or snow) tend to be predictable during a season. They know that the sun warms the land, air, and water. In Grade 2, students are introduced to the concept of gravity. In Grade 3, students know energy comes from the Sun to Earth in the form of light and that this energy can be carried by waves, such as water waves. They learn the path of the Moon’s orbit, and that the Earth is one of several planets in our solar system. They also know that these celestial bodies can be studied by magnifying them using equipment such as a telescope. In Grade 4, students learn about erosion and weathering, phenomena that are in part the result of prevailing or severe weather patterns.

The content for Grade 5 increases students’ understanding of previously learned material, and prepares them for deeper study of forces such as heat flow and energy in the Earth’s system in Grade 6, and gravity in Grade 8.

This module of the *Instructional Guide* is designed to provide teachers with a variety of resources to support implementation of the Grade 5 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 vocabulary list of all vocabulary for Grade 5 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. Core Vocabulary refers to terminology all students should master as a result of instruction. Additional Vocabulary refers to terms 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 reviewing and refining student understanding of the processes from Grade 4.

Immersion Unit – The Grade 5 Earth science Immersion Unit focuses on weather using a variety of activities. This unit integrates into activities and instruction computer-based simulations and animations that are provided in this Instructional Guide on a CD-ROM. It is advised that teachers begin this module using a selection of published resources to introduce the hydrologic cycle to students. Students will then explore the role that weather forecasting plays in society, develop understanding of the causes of severe weather phenomena, and investigate weather patterns and predictions. At the end of this Immersion Unit, teachers will provide students access to the content in the *Solar System* unit.

Units of Instruction – The units of instruction for Grade 5 Earth science include: *Water Cycle*, *Weather*, and *The Solar System*. 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 who are using the *Harcourt Science* program will need to supplement their program to ensure that students have access to 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 5 Earth Science Module, the *Weather Unit* includes 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 items on each of the Grade 4 standards in addition to all but one of the Grade 5 standards (standard 3e).

In examining the test blueprint, eleven (11) items on the test will be aligned with the five Grade 5 Earth science standards. Since almost all standards will be tested with at least one question, students should have a foundational understanding of the content in each of the Grade 5 Earth science standards.

- Particular care should be taken to discuss the terms “independent variable,” “dependent variable,” and “controlled variable.” These terms are used in the *California Science Framework*, and specific questions may be asked about these terms on the Grade 5 California Standards Test in science. In the words of the standards,

“Scientific progress is made by asking meaningful questions and conducting careful investigations.” In any investigation, there are factors (variables) that you control or accept (controlled or independent variables), and those that are dependent upon the question you are asking (dependent variables). The terms *controlled* and *independent* variables are used interchangeably in many texts all the way through high school, and even in some college texts (although the difference relates to the types of factors studied). Typically, a controlled variable is one that you not only control, you can manipulate. Typically, an independent variable is also one that you control (how often you make your observations), but do not manipulate (for example, you don’t change the number of minutes in an hour). Because you do have control over both of these variables, the terms are used interchangeably at this level by many texts, but there is a subtle distinction.

*“As marvelous as the stars
is the mind of the person
who studies them.”*

*- Martin Luther King, Jr.,
in Voyage to the Great
Attractor by Alan Dressler
(1995)*

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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.

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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.

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Grade 5 - Earth Science Content Standards

Key Knowledge and Concepts from the California Science Framework

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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).

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.

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**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 investigation based on a student-developed question.
- Students conduct a simple investigation 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.

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**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.

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 (H₂O)
 water demand
 water supply
 watershed
 weather balloon
 wind

Grade 5 Earth Science Vocabulary

Core

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



Periodic Assessment

As an integral element of the *Elementary Periodic Assessment Program*, the Grade 5 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.

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.

Calendar

Blueprint

The following *Periodic Assessment* blueprint shows the design for the Grade 5 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 all standards (Grades 4 and 5) are assessed.

Periodic Assessment Blueprint

| Standards | # Items |
|--|---------|
| 3. Water on Earth moves between the oceans and land through the processes of evaporation and condensation. As a basis for understanding this concept: | 9 items |
| 3a. <i>Students know</i> most of Earth’s water is present as salt water in the oceans, which cover most of Earth’s surface. | 1 |
| 3b. <i>Students know</i> 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. | 2 |
| 3c. <i>Students know</i> 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. | 3 |
| 3d. <i>Students know</i> 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. | 2 |
| 3e. <i>Students know</i> the origin of the water used by their local communities. | 1 |
| 4. Energy from the Sun heats Earth unevenly, causing air movements that result in changing weather patterns. As a basis for understanding this concept: | 8 items |

| Standards | # Items |
|--|---------|
| 4a. <i>Students know</i> uneven heating of Earth causes air movements (convection currents). | 1 |
| 4b. <i>Students know</i> the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns. | 2 |
| 4c. <i>Students know</i> the causes and effects of different types of severe weather. | 2 |
| 4d. <i>Students know</i> how to use weather maps and data to predict local weather and know that weather forecasts depend on many variables. | 2 |
| 4e. <i>Students know</i> 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. | 1 |
| 5. The solar system consists of planets and other bodies that orbit the Sun in predictable paths. As a basis for understanding this concept: | 6 items |
| 5a. <i>Students know</i> the Sun, an average star, is the central and largest body in the solar system and is composed primarily of hydrogen and helium. | 2 |
| 5b. <i>Students know</i> 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. | 3 |
| 5c. <i>Students know</i> the path of a planet around the Sun is due to the gravitational attraction between the Sun and the planet. | 1 |
| 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. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria. | ✓ |
| 6b. Develop a testable question. | |

| Standards | # Items |
|---|---------|
| 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure. | 25 |
| 6d. Identify the dependent and controlled variables 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. | |
| 6f. Select appropriate tools (e.g., thermometers, metersticks, balances, and graduated cylinders) and make quantitative observations. | |
| 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data. | |
| 6h. Draw conclusions from scientific evidence and indicate whether further 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. | |
| Total Items | |

Sample Items

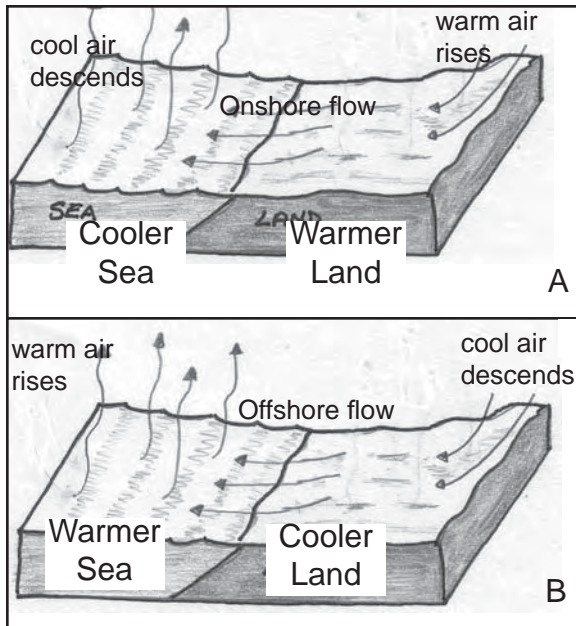
Weather

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 5 science standard 4a. "Students know uneven heating of Earth causes air movements (convection currents)." The examples show a range of difficulty and can be used to give students practice in responding to rigorous multiple-choice questions.

1. The graphic below shows the flow of air during sea and land breezes.



Which of the following statements is supported by the illustrations? **D**

- A. Image (a) shows airflow in the early morning.
- B. Image (a) shows airflow in the late evening.
- C. Image (b) shows airflow in the late morning.
- D. Image (b) shows airflow in the early evening.

2. Earth's weather systems get their energy from ____ **B**

- A. the Moon.
- B. the Sun.
- C. the land.
- D. the ocean.

Question #1 requires students to understand that warm air rises and cool air falls, setting up convection currents, known as wind. As the land warms from the Sun's energy, the air above the land rises. The rising air is replaced by cooler air from over the cool water, creating an "onshore flow." As the Sun sets, the land begins to cool down more quickly than the water. When the land becomes cooler than the water, the air over the water begins to rise and is replaced by cooler air from over the land, creating an "offshore flow." This question requires students to be familiar with reading sophisticated diagrams. In using a question such as this for instruction, the teacher would enlarge the diagram as much as possible until students are comfortable with the smaller format.

Question #2 requires students to understand that the primary source of energy driving the Earth's weather systems is the Sun. Part of the Sun's energy is then converted into heat that warms the land and oceans.

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 | 4a | D | (a) This cannot happen until the Sun has warmed the land. This will happen later than the morning hours. (b) In the evening, the air over the land is cooler than the air over the water and would create an offshore flow. (c) By late morning the air over the land is warmer than the air over the water and would create an onshore flow. (d) This answer is correct. |
| 2 | 4a | B | (a) The Moon reflects light from the sun. It does not generate energy. (b) This answer is correct. (c) The land is heated by the energy from the Sun. (d) The oceans are heated by the energy from the Sun. |

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 content standard (4a), while practicing Investigation and Experimentation standard 6c.

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: Explain the procedures in an investigation to model the uneven heating of the Earth using air, soil, and water. Be sure to list the data you would collect in order to make a conclusion.

The students' response should include the following:

- An organized series of steps including:
- Three jars of equal size, one with air, one half-filled with soil, and one half-filled with water
 - A thermometer put into each jar
 - Place the jars in the sun at the same time
 - Record the temperature of each jar at regular intervals
 - Graph the temperature readings
 - Once the jars are at their maximum temperature for the day, place them in the shade to record the speed at which the substances in the jars lose their heat

Question 4: Explain how the uneven heating of the Earth's surface results in climactic differences. Include a diagram to support your answer.



The students' response should include the following:

- The atmosphere and surface of Earth are heated unevenly in relationship to latitude; due to the angle of the Sun's rays hitting the Earth's surface, more energy hits nearest the equator and less energy hits the poles (the more oblique the angle of the Sun's rays to the Earth's surface, the same energy is spread over more land, and therefore the less heat hitting the surface at the poles compared with the equator).
- Due to the differences in how substances absorb heat, the heating of the oceans, land and air result in temperature differences.
- The uneven heating results in local and global temperature differences that create convection currents in the oceans and atmosphere. As warm air rises and cold air falls toward Earth's surface, convection currents in the air are developed (called winds).
- The diagram should show the Earth and the Sun and illustrate how the angle of the Sun's rays is perpendicular at the equator and oblique at the poles.

Sample Items

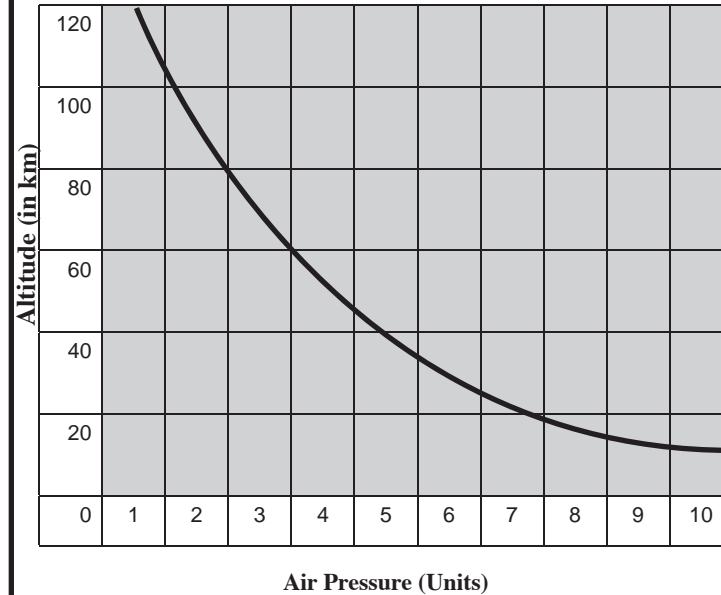
Investigation and Experimentation (I&E)

Multiple Choice

These examples are designed to assess students' knowledge of I & E standard 6g. "Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data." The examples show a range of difficulty and can be used to give students practice in responding to rigorous multiple-choice questions.





5. Based on the chart below, what is the relationship between air pressure and altitude? **C**

Relationship between altitude and air pressure



- A. The higher the altitude the higher the air pressure.
- B. The lower the altitude the lower the air pressure.
- C. The higher the altitude the lower the air pressure.
- D. The altitude does not affect the air pressure.

6. Using this chart, it could be inferred that the weather is getting ____ **D**

| Day | Time | Temp. | Rain-fall | Wind Direc-tion | Wind Speed (mph) | Cloud Cover |
|-----|------|-------|-----------|-----------------|------------------|---|
| 1 | 9 am | 82°F | 0 cm | W | 0 - 10 |  |
| 2 | 9 am | 79°F | 0 cm | NW | 10 - 15 |  |
| 3 | 9 am | 71°F | 1 cm | NW | 20 - 35 |  |
| 4 | 9 am | 68°F | 3 cm | N | 10 - 15 |  |

- A. colder and more windy.
- B. warmer with less cloud coverage.
- C. more cloud coverage and more wind.
- D. more rain with a change in wind direction.

Question #5 requires that students correctly interpret the line graph that shows increasing altitude on the vertical axis and increasing air pressure on the horizontal axis. At 120 km altitude, air pressure is less than 1 unit. At an altitude of less than 20 km, the air pressure is 10 units. Given this information, a student should infer that the higher the altitude, the lower the air pressure.

Question #6 asks students to examine a chart of weather data and look for patterns. For each of four days, weather data was taken at the same time of day. When examined, students will see that over the four days the temperature is progressively colder, rainfall has increased, wind direction has moved from the west to north, wind speed increased over the first three days, then decreased on the fourth day, and cloud coverage increased

steadily. Given this data, the student should infer which data has a steady pattern that is most likely to continue into day 5. In order to answer this and similar questions effectively, students need practice making charts and reading charts that are oriented both vertically and horizontally.

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 | 6g | C | (a) For this to be correct, the data line would move from the bottom left to the upper right corners. (b) For this to be correct, the data on the x-axis would need to be numbered from 120 at the bottom to 0 at the top. (c) This statement is correct. (d) Air pressure is the result of the weight of air acting on an object. The more air acting on an object, the greater the air pressure. |
| 6 | 6g | D | (a) The temperature is getting colder, but the winds are subsiding. (b) The temperature is decreasing and cloud cover is increasing. (c) Cloud coverage is increasing, but winds are decreasing. (d) This statement is correct. |



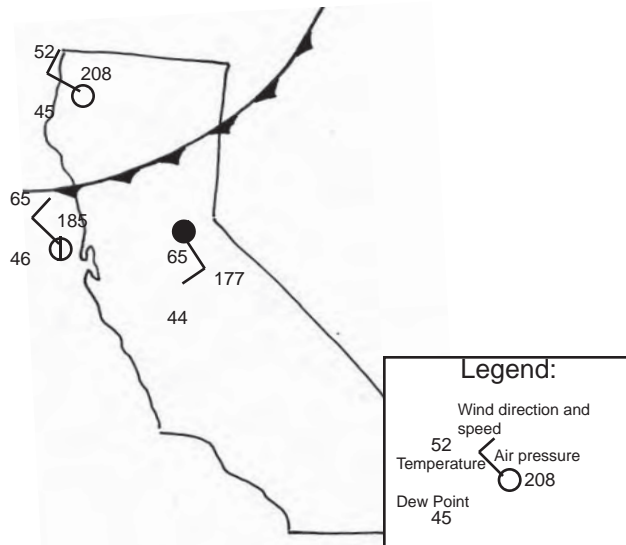
Open Response

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 (6g) as well as provide a context from the content standards.

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 may want to develop rubrics to assist in the scoring of student work. The *LAUSD Generic Scoring Guide for Written Products: Science* (see Appendix) may be helpful in the development of these rubrics.



Question 7: Examine the weather map provided.

Explain the system of symbols on the map. Who developed these symbols? Who might use them? How do the symbols interact? What information is provided, and how can local weather be predicted based on this information?

The students' response should include the following:

- The system of symbols was developed by meteorologists so that they could communicate internationally.
- The symbols provide information on wind direction and speed, temperature, dew point, air pressure, amount of cloud cover, and the location, direction, and type of front.
- Since weather patterns in North America predominantly travel from west to east, examining the weather to the west is one way meteorologists predict the next day's local weather including temperature and wind direction.

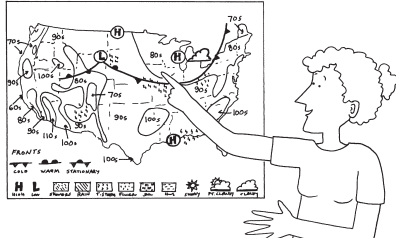
Question 8: Examine the chart provided:

| Day | Time | Temp. | Rain-fall | Wind Direc-tion | Wind Speed (mph) | Cloud Cover |
|-----|------|-------|-----------|-----------------|------------------|-------------|
| 1 | 9 am | 82°F | 0 cm | W | 0 - 10 | |
| 2 | 9 am | 79°F | 0 cm | NW | 10 - 15 | |
| 3 | 9 am | 71°F | 1 cm | NW | 20 - 35 | |
| 4 | 9 am | 68°F | 3 cm | N | 10 - 15 | |

Question 8: What instrument(s) would be used to gather this data? What patterns in the data can be identified? Graph the data so that inferences can be made about future weather.

The students' response should include the following:

- The student should list weather collection instruments such as a clock (for time), a thermometer (for temperature), a rain gauge (for rainfall), and a wind sock or anemometer (for wind direction and wind speed).
- Students can identify patterns in increasing rainfall, changing wind direction, and increased cloud cover.
- Students can create line graphs of temperature, rainfall and wind speed. Graphs should be properly labeled.



Weather Satellites and Weather Forecasting

Fifth Grade Earth Science Immersion Unit

Please note the following is a field-test draft of a 5th grade Weather Satellites and Weather Forecasting Immersion Unit. This unit was developed and is being tested and revised by teachers, scientists, and curriculum developers associated with the NSF-funded Math/Science Partnership, System-wide Change for All Learners and Educators (SCALE). This unit builds off of the research and educational outreach materials from the Space Science and Engineering Center at the University of Wisconsin - Madison. The entire unit, including the most current revisions of teacher and student pages, is available from the SCALE website <http://www.wcer.wisc.edu/> Please direct any questions and comments to: immersionquestions@workspace.wcer.wisc.edu.

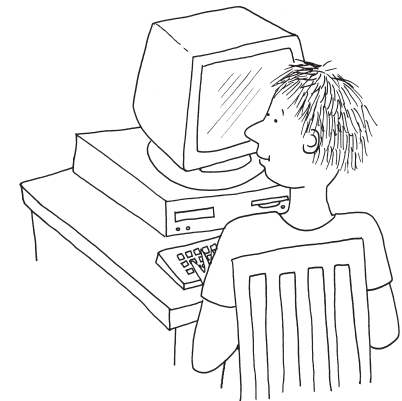
Overview

In this unit, students have an opportunity to develop an understanding of the key tools and methods that meteorologists use to gather and interpret weather data. Students also learn how meteorology informs decisions that humans make. For example, students learn about weather satellite orbits and imagery.

This unit is computer based and focuses on using data to look for regional weather patterns. Students learn about severe weather and its causes, use weather satellites to monitor and forecast the weather, and apply their understanding to develop a forecast for a fictional event in a particular region of the continental United States.

The implementation materials are available on-line at <http://cimss.ssec.wisc.edu/SCALE/grade5/>, and are also available on CD-ROM. By using remotely sensed images and offering several hands-on interactive activities, this unit integrates technology with instruction to provide immediate feedback to students as they practice and develop satellite interpretation skills, explore different weather phenomena and analyze weather maps. If access to computers is limited, students can work in pairs or take turns using the CD-ROM. In one set of activities, the graphics and interactive Teaching Applets are projected and used in a whole-class activity. Along with striking satellite images, satellite animations, and interactive imagery, this unit features Teaching Applets where interactive computer programs make it possible for students to explore and better visualize weather phenomena.

At the beginning of the Weather Satellites and Weather Forecasting Immersion Unit, students become engaged with the unit content through reading about the role that severe weather played in the Donner Party tragedy. Building off of their discussion of the reading, students will explore weather maps and learn how scientists generate, read and interpret the images to find patterns that make it possible to forecast and understand severe weather.



Students are then given the challenge to imagine planning an important outdoor event in a particular region of the United States. They generate questions about how weather might affect their event and research past weather data from a variety of sources to learn about the weather patterns in their chosen region. Students read regional weather information that explains the scientific explanation for the observed weather patterns and compare that information to their own data interpretation and explanation.

There are two parts to the culminating activity for this unit, first students will make inferences about the weather in the region by explaining why the data they collected suggests that they should hold their event on the dates they have chosen. And second, students will research and interpret current weather forecasting data and compare current weather predictions in the region to the weather they hope to have during their event. Students will prepare oral and written materials to present their evidence-based explanation of their findings to their peers for feedback and questions to deepen their understanding of forecasting weather.

Overarching Concepts

The overarching concepts that students will study in this Immersion Unit are:

- Scientists' ability to gather and interpret weather data helps us make informed choices that can improve the way we live on Earth.
- Before humans had knowledge of or ability to gather and interpret weather data, we were even more susceptible to weather-related catastrophes.
- On Earth, there are many different kinds of severe weather phenomena, and scientists now understand a lot about their causes.
- Satellite imagery is a tool that meteorologists use to better understand weather.
- Anyone who understands how to read and interpret satellite images and has access to weather data can use that data to better understand and predict weather patterns in a particular region.



Guiding Questions

Explore: What were the consequences for humans before it was possible to predict weather patterns and monitor storms? What were the ways that humans first tried to gather weather data? Were those methods effective?

Think: What types of severe weather are there on Earth? What causes severe weather? What do weather maps and satellite images tell us about the weather? Why is so hard for weather forecasters to accurately predict the weather?

Collect: What types of weather data are available for me to use to understand weather patterns in a particular region of the United States or where I live?

Quantify: What types of measurable data can I collect about the weather where I live? How does measurable data relate to forecasting?

Draw: How are weather data represented through drawings, maps and symbols?

Record: How will you record information from satellite images and use it to analyze the weather in a particular region?

Graph: How do you read weather data graphs to get information about weather patterns in a particular region?

Share: How can you best share your research and explanations with your classmates and teachers? What questions can you ask your peers to help them draw logical conclusions from their research? What did you learn about weather, and how did you learn it? What additional questions do you have?

California Grade 5 Standards

(specific references to the standards are found in the implementation section of this immersion unit)

Earth Science Strand

Standard Set 3: *Energy from the Sun heats Earth unevenly, causing air movements that result in changing weather patterns. As a basis for understanding this concept:*

3a. *Students know* uneven heating of Earth causes air movements (convection currents)

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

4b. *Students know* the influence that the ocean has on the weather and the role that the water cycle has in weather patterns.

4c. *Students know* the causes and effects of different types of severe weather.

4d. *Students know* how to use weather maps and data to predict local weather and know that weather forecast depend on many variables.

4e. *Students know* that the Earth's atmosphere exerts a pressure that decreases with distance above the Earth's surface and that at any point it exerts this pressure equally in all directions.



Student Outcomes

Content

By participating in this unit, students will:

- develop an appreciation for the concept that the atmosphere and surface of the Earth are heated unevenly, giving rise to both local and global temperature differences,
- understand that the process of hot air rising and cold air sinking occurs at Earth's surface on many different scales, causing local winds and great global air currents, such as trade winds,
- recognize that temperatures are higher at the equator than farther north or south, but the difference would be much more extreme without the influence of the oceans,
- understand the causes and consequences of being able to better predict the occurrence of many types of severe weather in the world: hurricanes, tornadoes, thunderstorms, and monsoons,
- recognize that the source of energy for all weather is the Sun,
- develop an appreciation for the concept that warm air tends to be less dense than cold air, and air will always flow

(blow) from areas of high pressure (denser air) toward areas of lower pressure, creating winds,

- identify that contacts between air masses with different temperatures are called fronts,
- understand that weather maps display data on air temperature, air pressure, and precipitation,
- recognize that the fact that air flows from regions of high pressure to regions of low pressure makes it possible to look at a weather map and predict the direction of the wind,
- develop an appreciation for the principle that atmospheric pressure is greatest near Earth's surface at sea level and diminishes with increasing height in the atmosphere, and
- understand that advances in science and technology make it possible now to better predict regional weather trends and severe weather events, providing important information for society.



Habits of Thinking

By participating in this unit students will

- understand that scientific investigations may take many different forms, including conducting research to answer a scientific question,
- understand that in science, statements must be supported by facts found in books, articles, and databases, with those sources used identified,
- develop an appreciation for modeling and simulations as tools to help us understand natural phenomena, and
- develop an awareness of the contributions that weather satellites provide to society.

Assessment

The summative assessment for this Immersion Unit occurs in two parts. In the first part, students develop a brochure that explains the fictional event they have scheduled to occur at a specific time in a particular region. The brochure will provide students with an opportunity to demonstrate their understanding of and ability to interpret weather data. In the second part of the culminating activity, students research and interpret current weather forecasting data in the region illustrated in the brochure and compare current weather predictions to the weather described in the brochure. In this way, students further reflect on and apply their experiences from the Immersion Unit to analyze weather data.

Throughout the activities in the Immersion Unit, opportunities are included for formative assessment to occur and inform instructional strategies. Suggestions for questions that will help reveal student understanding of key concepts are included in the teacher's pages of the implementation section. In addition, individual or team formative assessment opportunities are built into the activities in the form of reflection questions. These questions can be given to students individually or in groups. You may wish to collect students' written short-answer responses or use the questions to focus small-group or whole-class discussions where students' conceptions are made public.



Storyline for Unit

Step 8

Students gather current forecast data for their chosen region and prepare an oral or written report that explains current weather and how that compares to the weather they hope to have during their event. Evidence-based explanations for the comparison are emphasized. Peers provide feedback and questions to deepen understanding.

STEP 7

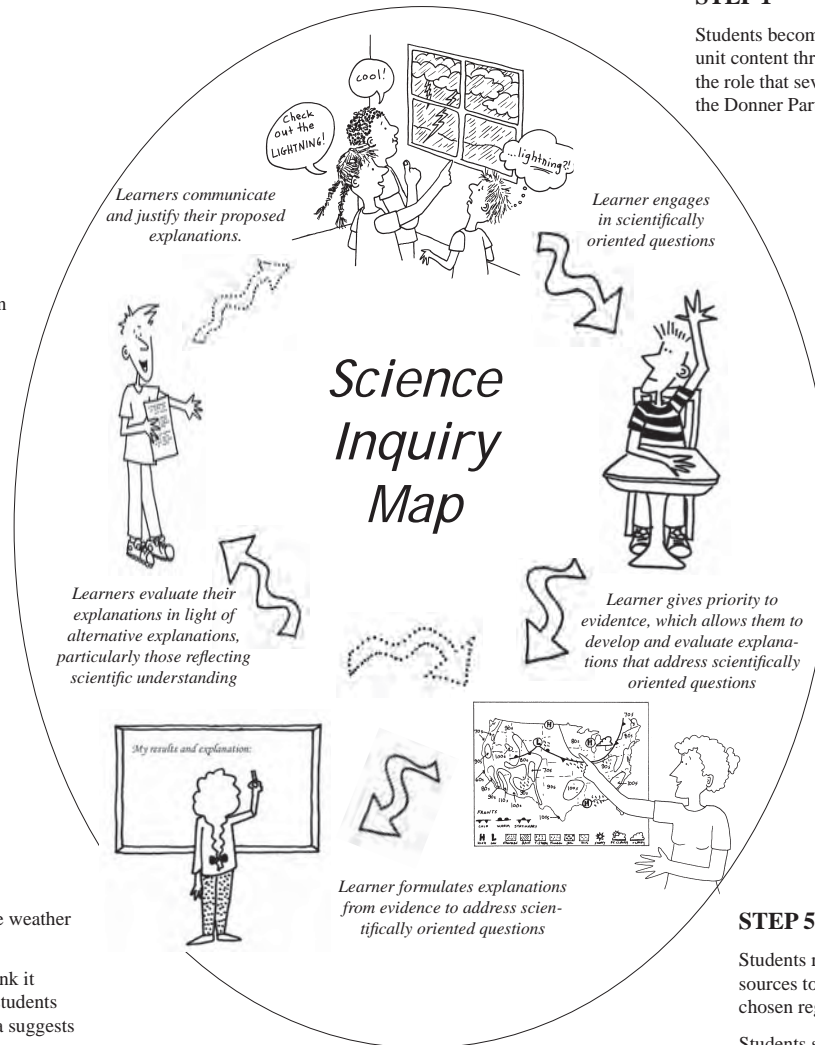
Students read regional weather information that explains the scientific explanation for the observed weather patterns in their chosen region and compare that information to their own data interpretations and explanations.

Students revise their own explanations as needed and create a brochure about their event that includes an explanation for the timing chosen in relation to the region's weather.

STEP 6

Students make inferences about the weather patterns in their chosen region.

After selecting dates when they think it would be best to hold their event, students write explanations for why the data suggests those dates are better than others.



STEP 1

Students become engaged with the unit content through reading about the role that severe weather played in the Donner Party tragedy.

STEP 2

Students explore weather maps and satellite imagery and learn how scientists generate, read and interpret these images to find patterns that make it possible to forecast the weather.

STEP 3

Students explore severe weather phenomena and learn the scientific explanations for causes and influencing factors

STEP 4

Students are given the challenge to imagine planning an important outdoor event in a particular region of the United States. Students generate questions about how weather might affect their event in their chosen region.

STEP 5

Students research weather data from a variety of sources to learn about weather patterns in their chosen region.

Students select appropriate data for answering their own questions about weather in the region that likely would affect their event.





Water Cycle Unit

The *Water Cycle* unit is focused on building students' understanding of the process by which water moves between the land, atmosphere, and the oceans. Students focus on where water is found in large and small quantities, and that water moves because of changes in temperature. This builds a foundation for an understanding of convection currents that students will deepen later in Grade 6.

Students are introduced to factors that control clouds, precipitation and other phenomena that will be developed further in the *Weather* unit.

Within the *Water Cycle* unit, students will also explore where usable fresh water is located and the role of the watershed in moving water across a geographic area. As part of students' realization that there is a limited amount of usable fresh water, they may explore ways to conserve and recycle available resources. Students should learn the origin of the water they use, tracing it to its source.

Across Los Angeles there are many resources to support an enriched study of our water system. The city's museums, Department of Water and Power, and the California Environmental Protection Agency, among others, have a wide variety of resources, curriculum, and field trip opportunities that focus on the water cycle and water use across Los Angeles. 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 3a – 3e, with significant support for building science process skills in I&E standards 6b – 6i.

California Academic Content Standards:

- 3a. *Students know* most of Earth's water is present as salt water in the oceans, which cover most of Earth's surface.
- 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.
- 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.
- 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.
- 3e. *Students know* the origin of the water used by their local communities.
- 6b. Develop a testable question.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6d. Identify the dependent and controlled variables 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.
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and





make inferences based on those data.

- 6h. Draw conclusions from scientific evidence and indicate whether further 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.

Vocabulary – The core vocabulary for the *Water Cycle* unit focuses on the processes and products of the water cycle. Supplemental vocabulary reflects terminology students may have been introduced to in Grades 1 and 3, and terms that they will become familiar with as a result of water cycle activities. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons – If using the *Harcourt Science* program, the resources listed provide access to the content standards in this unit, therefore no additional lessons are provided.

Critical Questions

- What are the steps in the process by which water moves between the land and oceans?
- What are the four types of precipitation and how are they different?
- What is the origin of fresh water in our local community?
- What are the sources of fresh and salt water in our watershed and how can the availability of freshwater be extended?

QUESTIONS?



Connections

The following are optional connections that can be made across the curriculum. Specific standards citations for these connections can be found in published 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. Knowing the Greek or Latin derivation of these terms can be helpful.

Mathematics: There are many opportunities for students to practice graphing skills. The most difficult is determining the correct graphic representations based on the data and the questions to be analyzed.

History-Social Science: As students study the United States and regional characteristics of this country, learning about access to water can deepen their understanding of population density, agriculture as an economic base, and natural phenomena that result in cultural differences.

Health: Students can relate their use of water to their overall health and well-being. They can examine water-borne disease (both current and historical) and examine their own oral hygiene in terms of water use (e.g., brushing teeth, bathing).

Visual and Performing Arts: Many cultures create art reflective of water within the landscape. Many cultures work to honor and reflect the importance of water to life itself.

Background

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

Demonstrating the water cycle in the classroom can be challenging. There are many curriculum guides with “cloud in a bottle” demonstrations, but they can be unreliable depending on the humidity levels. Students can observe condensation and its relationship to other weather factors by examining a glass of ice water on days with high and low humidity (check your weather report) to see that the quantity of water condensation differs based on the amount of humidity in the air.

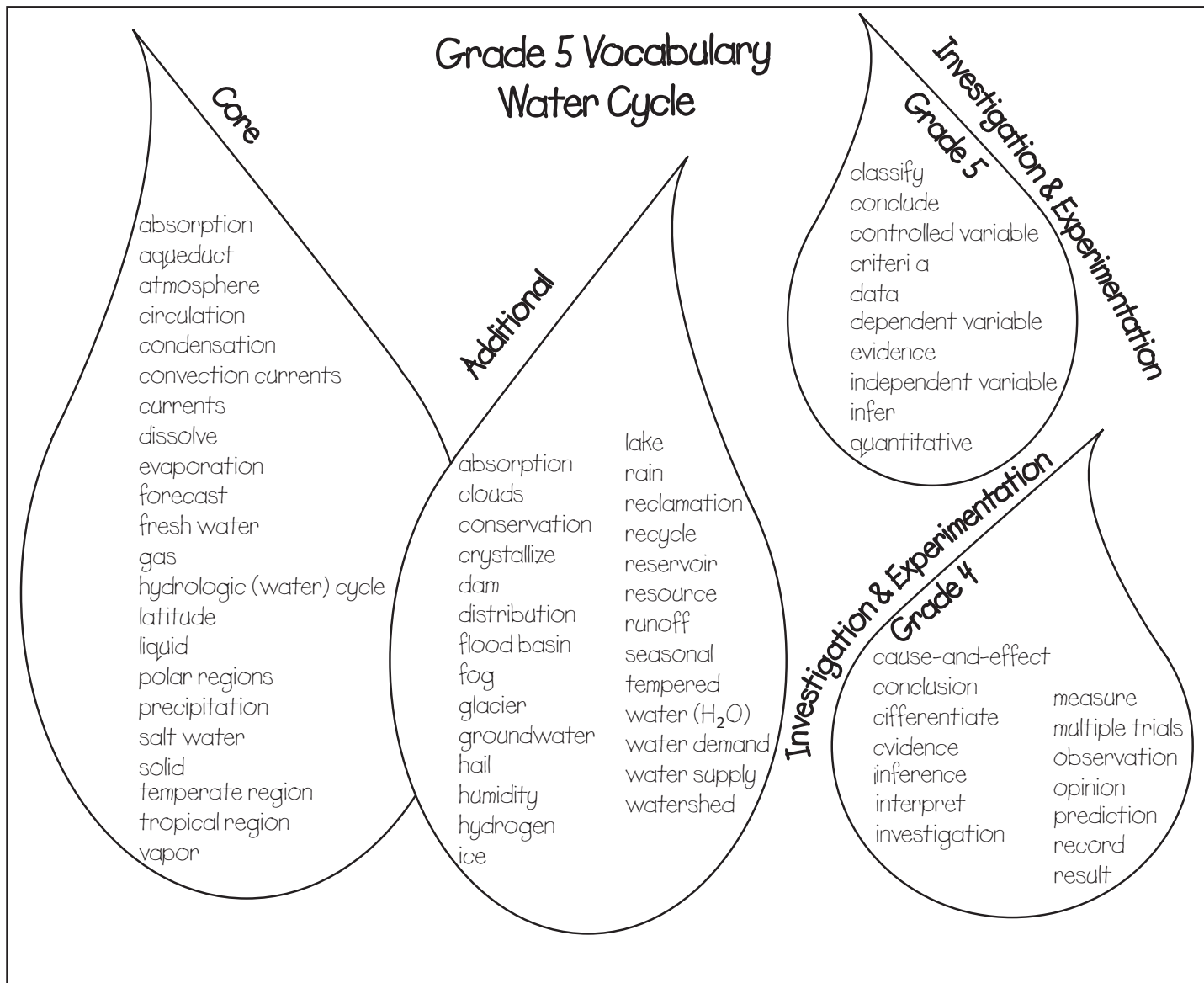
Grade 5 Earth Science-Water Cycle Unit Introduction

Los Angeles Unified School District

“An ocean traveler has even more vividly the impression that the ocean is made of waves than that it is made of water.”



- Arthur S. Eddington (1882-1944) English astronomer and physicist. *The Nature of the Physical World*, Cambridge (1929)





California Academic Content Standards:

- 3a. *Students know* most of Earth’s water is present as salt water in the oceans, which cover most of Earth’s surface.
- 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.
- 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.
- 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.
- 3e. *Students know* the origin of the water used by their local communities.
- 6b. Develop a testable question.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6d. Identify the dependent and controlled variables 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.
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- 6h. Draw conclusions from scientific evidence and indicate whether further 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.

|  My notes | HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | |  My notes |
|--|---|--|--|---|--|
| | RESOURCE | NOTES | RESOURCES | NOTES | |
| | <p style="text-align: center;">Chapter 1</p> <ul style="list-style-type: none"> • Lesson 2, <i>How Are Atmospheric Conditions Measured?</i> pg. B10–17 • WB 73 • Lesson 3, <i>What Role Do Oceans Play in the Water Cycle?</i> pg. B18–23 | <ul style="list-style-type: none"> • Focus on the role of the water cycle in weather; Types of clouds are beyond the standard • <i>Getting Fresh Water From Salt Water</i>, pg. B18-19, has many variables to discuss and explore. | <p style="text-align: center;">The Water Cycle</p> <p>FOSS: <i>Water Investigation 1, Science Stories</i></p> <ul style="list-style-type: none"> • <i>A Report from the Blue Planet</i>, pg. 1-2 Investigation 3 • <i>Water Vapor</i>, Part 4, 22-26 | <ul style="list-style-type: none"> • Focus on condensation | |





HARCOURT SCIENCE TEXTBOOK

SUPPLEMENTAL

* Resources are organized by topic



| RESOURCE | NOTES | RESOURCES | NOTES |
|--|---|--|--|
| <ul style="list-style-type: none"> • WB 74-75 • Investigation Challenge, p. B21 • Lesson 4, <i>Why is the Water Cycle Important?</i> pg. B24–29 • WB 78-79 • WB 80 • WB 81 • Investigation Challenge, p. 26 • <i>Wetlands with a Purpose</i>, pg. B30–31 • Assessment, pg. AG 34-45 | <ul style="list-style-type: none"> • <i>Water, Water Everywhere</i>, pg. B24-25, should include measurement of water inside the bag. Be sure to do <i>Investigate Further</i> • Focus on Questions 1-3 • Include diagram | <p>The Water Cycle</p> <p>FOSS: <i>Water</i> Investigation 3, <u>Science Stories</u></p> <ul style="list-style-type: none"> • <i>Wet and Dry Places</i>, p. 12 • <i>Evaporation and Condensation</i>, p. 13 • <i>The Water Cycle</i>, pg. 14-16 <p>Investigation 4, <u>Science Stories</u></p> <ul style="list-style-type: none"> • <i>Water: A Vital Resource</i>, p. 17 • <i>Water Coming into our Homes</i>, p.18 • <i>Water Leaving Our Homes</i>, p. 19 • <i>Runoff</i>, pg 20 • <i>Water Conservation</i>, p. 21 <p>FOSS - Solar Energy Investigation 2</p> <ul style="list-style-type: none"> • <i>The Sun, the Ocean, and the Weather</i>, pg. 22-23 | <ul style="list-style-type: none"> • Focus on water treatment |



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HARCOURT SCIENCE TEXTBOOK

SUPPLEMENTAL

* Resources are organized by topic



RESOURCE

NOTES

RESOURCES

NOTES

- Project WET
- *Molecules in Motion*, p. 47
 - *Imagine!* p. 157
 - *Incredible Journey*, p. 161
 - *Old Water*, p. 171
 - *Sum of the Parts*, p. 267
 - *Water Meter*, p. 271
 - *Water Works*, p. 274
 - *Every Drop Counts*, p. 307
 - *Water concentration*, p. 407

- California Water Story
- Lesson 1: *California Geography*, p. 3-5
 - Lesson 2: *The Water Cycle*, p. 6-10
 - Lesson 3: *The History of Water Use in California*, p. 11-14
 - Lesson 4, parts B-D: *Water Use Today*, p. 15-18
 - Lesson 5: *Personal Water Conservation*, p. 18-21
 - Lesson 6: *Protecting the Quality of Our Water*, p. 22-24

- Lessons 1-3 connect with History – Social Science standards on settlement patterns, geological features of regions and territories, and the experience of settlers over land trails to the West.



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| Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | | Notes | |
|---------------------------|---|-------|----------------------------------|----------|----------|----------|----------|----------|----|----|----|----|----|----|----|----|----|-------|---|
| | | | ES 3a | ES 3b | ES 3c | ES 3d | ES 3e | ES 4d | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | 6i | | |
| California Water Story | Lesson 1: <i>California Geography</i> | 3-5 | | | | | ▼ | | | | | | | | | | | | Students examine a map of California to determine the sources and path of local water. |
| | Lesson 2, parts A and B: <i>The Water Cycle</i> | 6-10 | | ▼ | | | | | | | | | | | | | | | Students build a water sill and examine a poster of the water cycle with questions to answer. |
| | Lesson 2, part C: <i>The Water Cycle</i> | 6-10 | ▼ | | | | ▼ | | | | | | | | ▼ | | | | Students research rainfall in California, graph and answer questions about the availability of fresh water. |
| | Lesson 3: <i>The History of Water Use in California</i> | 11-14 | | | | | ▼ | | | | | | | | | | | | Students watch a video on water use across the state and discuss. |
| | Lesson 4, parts B-D: <i>Water Use Today</i> | 15-18 | | | | | ▼ | | | | | | | | | | | | Students examine where cities get their water. |
| | Lesson 5: <i>Personal Water Conservation</i> | 19-21 | | | | | ▼ | | | | | | | | ▼ | | | | Students gather quantitative data on their water use and develop strategies to conserve. |

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



| S | Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | Notes | | |
|---|---|---|-------|----------------------------------|-------|-------|-------|-------|-------|----|----|----|----|----|----|----|----|-------|---|--|
| | | | | ES 3a | ES 3b | ES 3c | ES 3d | ES 3e | ES 4d | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i | |
| t a n d a r d s A l i g n m e n t | | Lesson 6: <i>Protecting the Quality of Our Water</i> | 22-24 | | | | ▼ | | | | | | | | | | | | Students explore aquifers and the challenges of cleaning polluted water. Students brainstorm alternative cleaning products for use at home. | |
| | FOSS: Solar Energy | Investigation 2 – Science stories: <i>The Sun, the Ocean, and the Weather</i> | 22-23 | | ▼ | ▼ | | | | | | | | | | | | | | |
| | FOSS: Water | Investigation 1: <i>A Report from the Blue Planet</i> | 1-2 | ▼ | ▼ | ▼ | ▼ | | | | | | | | | | | | | |
| | | Investigation 3 – Science Stories: <i>Wet and Dry Places</i> | 12 | | ▼ | | | | | | | | | | | | | | | |
| | | Investigation 3 – Science Stories: <i>Evaporation and Condensation</i> | 13 | | ▼ | | | | | | | | | | | | | | | |
| Investigation 3 – Science Stories: <i>The Water Cycle</i> | | 14-16 | ▼ | ▼ | ▼ | | | | | | | | | | | | | | | |
| | Investigation 3, part 4: <i>Water Vapor</i> | 22-26 | | ▼ | | | | | | | | ▼ | | | | | ▼ | ▼ | Focus on concept of condensation | |

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



| 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 3a | ES 3b | ES 3c | ES 3d | ES 3e | ES 4d | 6a | 6b | 6c | 6d | 6e | 6f | 6g | | 6h | 6i | | |
| | | Investigation 4 – Science Stories: <i>Water: A Vital Resource</i> | 17-21 | ▼ | | | ▼ | | | | | | | | | | | | | | |
| | | Investigation 4 – Science Stories: <i>Water Coming into our Homes</i> | 18 | | | | | ▼ | | | | | | | | | | | | Water treatment is not the process used in Los Angeles | |
| | | Investigation 4 – Science Stories: <i>Water Leaving Our Homes</i> | 19 | | | | | ▼ | | | | | | | | | | | | | |
| | | Investigation 4 – Science Stories: <i>Runoff</i> | 20 | | | | ▼ | ▼ | | | | | | | | | | | | | |
| | | Investigation 4 – Science Stories: <i>Water Conservation</i> | 21 | | | | | ▼ | | | | | | | | | | | | | |
| | Harcourt, Chapter 1, Lesson 2 | Measuring Atmospheric Conditions | B10-11 | | | | | | ▼ | | | | | | ▼ | ▼ | ▼ | | | An activity in which students measure atmospheric conditions. | |
| | | Weather | B12-13 | | | ▼ | | | | | | | | | ▼ | | | | | | Text |
| | | Water in the Air | B15 | | ▼ | ▼ | | | | | | | | | | | | | | | Text - Focus on “The Inside Story” illustration |

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



| S | Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | Notes | | |
|---|-------------------------------|--|----------|----------------------------------|-------|-------|-------|-------|-------|----|----|----|----|----|----|----|----|-------|---|--|
| | | | | ES 3a | ES 3b | ES 3c | ES 3d | ES 3e | ES 4d | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i | |
| t a n d a r d s A l i g n m e n t | | Lesson Concept Review: <i>What Role Do Oceans Play in the Water Cycle?</i> | WB 73 | | ▼ | | | | ▼ | | | | | | | | | | % Salinity section has errors regarding polar regions | |
| | Harcourt, Chapter 1, Lesson 3 | Getting Fresh Water from Salt Water | B18 – 19 | ▼ | ▼ | | | | | | | | ▼ | | | | | ▼ | ▼ | Students build a solar still. There are many variables and this may not work as described. This does not require modeling clay. The small glass jar needs to have a wide mouth. Aligned to 6d if students discuss dependent and controlled variables. Aligned to 6h if students add accurate measurements. Aligned to 6i if students write a report. |
| | | Investigate Log | WB 74-75 | ▼ | ▼ | | | | | | | | | ▼ | | | | | ▼ | ▼ |

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| 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 3a | ES 3b | ES 3c | ES 3d | ES 3e | ES 4d | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i | |
| | | Ocean Water | B20-23 | ▼ | ▼ | ▼ | | ▼ | | | | | | | | | | | | Text - Focus on illustration of watershed, pg. 20-21; Density of salt water illustrations are an introduction to Grade 6: 1b; Note that % salt water in pie chart data is different on page B22 and B27 |
| | | Investigative Challenge: <i>Round and Round it Goes</i> | B21 | | ▼ | ▼ | | | | | | | | | | | | | | Best used as a demonstration |
| | Harcourt Chapter 1, Lesson 4 | Water, Water Everywhere | B24-25 | | ▼ | | | | | | ▼ | ▼ | | | ▼ | | ▼ | | | If students measure the amount of water in the bag, quantitative measurement can help students draw conclusions. |
| | | Drawing Conclusions | WB 78-79 | ▼ | | | | | | | ▼ | | ▼ | ▼ | ▼ | ▼ | ▼ | | | To be used with the activity, <i>Water, Water Everywhere</i> . |
| | | Process Skills Practice: <i>Infer</i> | WB 80 | | | | | | ▼ | | | | | | | | | | | This is very difficult without a diagram |
| | | Investigative Challenge: <i>Water World</i> | B26 | | ▼ | | | | | | | | | | | | | | | The container is not big enough to let droplets of "rain" form. Water will travel down the sides of the container. |

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| 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 3a | ES 3b | ES 3c | ES 3d | ES 3e | ES 4d | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i |
| | | Why the Water Cycle is Important | B26-27 | ▼ | | | ▼ | ▼ | | | | | | | | | | | Text |
| | | Humans and the Water Cycle | B28-29 | | | | ▼ | | | | | | | | | | | | |
| | | Lesson Concept Review: <i>Why is the Water Cycle Important</i> | WB 81 | ▼ | | | | | | | | | | | | | | | |
| | Harcourt Chapter 1 | Wetlands with a Purpose | B30-31 | | | | ▼ | | | | | | | | | | | | Text – [note: pollutants are going into the soil of the wetland, magnifying the negative effect of pollution.] |
| | | Assessment: <i>The Water Cycle</i> | AG 34-35 | | ▼ | | | | | | | | | | | | | | |
| | | Molecules in Motion | 47 | | ▼ | | | | | | | | | | | | | | |
| | | Imagine! | 157 | | ▼ | ▼ | ▼ | | | | | | | | | | | | |
| | | Incredible Journey | 161 | | ▼ | ▼ | | | | | | | | | | | | | |
| | | Old Water | 171 | ▼ | | ▼ | ▼ | | | | | | | | | | | | |
| | | Sum of the Parts | 267 | | | | | ▼ | | | | | | | | | | | Students simulate the effects of point and non-point pollution |

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



| S | Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | Notes | |
|---|--|----------------------|-------|----------------------------------|-------|-------|-------|-------|-------|----|----|----|----|----|----|----|----|-------|---|
| | | | | ES 3a | ES 3b | ES 3c | ES 3d | ES 3e | ES 4d | 6a | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i |
| t a n d a r d s | Project WET | Water Meter | 271 | | | | | ▼ | | | | | | | ▼ | ▼ | | | Students construct a water meter to keep track of their water use. |
| | | Water Works | 274 | | | | ▼ | ▼ | | | | | | | | | | | Students create a web of the interdependence among water users and producers |
| | | Every Drop Counts | 307 | | | | ▼ | ▼ | | | | | | | | | | | |
| | | Water Concentration | 407 | | | | ▼ | ▼ | | | | | | | | | | | Students play “concentration” to contrast water use choices now and in the past. |
| A l i g n m e n t | Waves, Wetlands and Watersheds Chapter 5 | A drop in the Bucket | 45-48 | ▼ | | | ▼ | | | ▼ | | | | | | | | | A demonstration in which students see the availability of water (by water source). |
| | | Alice in Waterland | 49-55 | | | | | ▼ | | | | | | | | ▼ | | | Students take a virtual trip through the water system to learn its path. Students chart water use before and after to determine a change in behavior. |
| | | Branching Out | 56-59 | ▼ | | | | ▼ | | | | | | | | | | | Students build a model of a watershed and examine how water moves through it. |

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Weather Unit

Introduction

The *Weather* unit allows students the opportunity to explore the causes of large-scale and small-scale movements in the atmosphere. They apply their knowledge of the hydrologic cycle to understanding weather and weather patterns.

As a basis for understanding weather patterns, students learn that the uneven heating of the Earth drives the temperature-driven convection currents called winds. These currents are similar to those examined in the *Water Cycle* unit. In addition, students begin to understand the role the hydrologic cycle plays in weather patterns, including the causes and effects of different types of severe weather. As students examine the properties of air, they begin to understand air pressure as a “pushing” force acting in all directions simultaneously on all objects. Students practice reading weather maps and data to predict local weather, and can determine why long-range weather forecasting is difficult.

Across Los Angeles there are many resources to support the study of weather. The city’s museums, Beaches and Harbors, and the Environmental Protection Agency, among others, have a variety of resources, curricula, and field trips that focus on the causes and effects of weather. 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 related issues.

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

California Academic Content Standards:

4a. *Students know* uneven heating of Earth causes air movements (convection currents).

- 4b. *Students know* the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns.
- 4c. *Students know* the causes and effects of different types of severe weather.
- 4d. *Students know* how to use weather maps and data to predict local weather and know that weather forecasts depend on many variables.
- 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.
- 6b. Develop a testable question.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6d. Identify the dependent and controlled variables 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.
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- 6h. Draw conclusions from scientific evidence and indicate whether further 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.



Vocabulary – The core vocabulary for the *Weather* unit focuses on the causes and effects of small and large scale weather patterns. Additional vocabulary reflects terminology students may have been introduced to in Grades 1, 2 and 3, and terms that they will become familiar with as a result of activities about weather. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons – The additional lessons for this unit are: *Pouring CO₂*, *Crushed Can*, *A Difference in Pressure*, *Heat Distribution*, and *Convection Currents*.

Critical Questions

- What are the driving forces that create *wind*?
- What is the role of oceans and the water cycle in weather?
- What are the causes and effects of different types of severe weather such as cyclones, hurricanes, tornadoes, thunderstorms and monsoons?



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. Knowing the Greek or Latin derivation of these terms can be helpful.

Mathematics: In examining weather maps and charts, there are many opportunities for students to practice graphing and charting skills. The most challenging is the ability for students to determine the correct graphic representation based on the data and the question to be analyzed.

History-Social Science: As students study the United States and regional characteristics of this country, students’ understanding of weather patterns can deepen their understanding of population density, agriculture as an economic base, and natural phenomena that result in cultural differences.

Health: Students can relate their study of weather to their health and well-being. They can examine the effects of weather on their personal health (e.g., heat exhaustion, safety practices during severe weather phenomena).

Visual and Performing Arts: There are a number of cultures that create art reflective of weather phenomenon. Many cultures create poems, paintings, rituals, and sculpture to honor and reflect the power of the weather over many aspects of cultural life.

Background

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

- The purpose of the *Additional Lessons* in this unit are to help students visualize how air moves. Air has many properties similar to that of a liquid. In *Pouring CO₂*, students will see that gases can move like a liquid by being “poured” down a trough. In *Crushed Can*, students can visualize that pressure occurs equally in all directions. *A Difference in Pressure* shows that different air pressures can be made visible. *Heat Distribution* works with the concepts from *A Difference in Pressure* to help students visualize why the Earth is warmer in some areas and colder in other areas. *Convection Currents* helps students visualize what happens when cold and warm bodies of air meet.
- Helping students distinguish between clouds and fog is challenging. Depending on when the lesson is taught,





there may be weeks at a time when the humidity remains constant, making it difficult to show the effect of the differences in levels of water vapor. When warm water vapor is in contact with cool air, clouds can form.

- This can be observed by breathing on a cold morning. The “cloud” dissipates because there isn’t enough water vapor to maintain it. It can then be explained that clouds form at particular elevations based on the surrounding air temperature.
- On density: In Grade 5, students are required to know the concept that warm air rises and cool air sinks. In Grade 8, students are responsible for knowing the concept of density (mass/volume=density).
 - When air is warmed, air molecules gain more energy and therefore occupy a greater volume of space. Because the volume (the denominator in the fraction above) increases, the density decreases ($1/8$ is smaller than $1/4$). Warm air is less dense than cool air. Therefore, warm air will rise through cool air. A discussion of hot air balloons can be used to illustrate this phenomenon, with a detailed discussion of why this works left for Grade 8.
- On severe weather systems: Depending on the size of the air masses and the difference of temperature between them, when surrounding cool air moves to take the place of rising warm air, the resulting movement of air (winds) may be deflected into circular patterns (caused by the Earth’s rotation). When this occurs on a large scale, it is called a cyclone, and depending in which hemisphere the cyclone occurs, a cyclone that develops winds greater than 119 km/hr may be called a hurricane.
- Temperature differences that cause cyclones depend on the heating of the atmosphere and the oceans during particular seasons, which is why there are certain times of the year

when these severe weather systems are more common.

- On weather prediction tools: The *California Framework* asks that students be knowledgeable with the common tools for quantitative measurement related to the content of Earth science, but does not identify any specific tools that students should know. The textbook and supplemental resources provide a number of sample tools including the opportunity to build some simple weather measurement tools. These are possible examples for the teacher to draw upon as relevant to overall instruction.
- In this unit on weather there are many opportunities for students to collect data and display it graphically. Students may find which type of graphic illustration to use when charting data to be very challenging. By providing students with multiple opportunities to choose between bar, line, and pie graphs, and asking students to justify their selections, students will become more adept at choosing the correct graphic illustration for charting their data.



“The purpose of models is not to fit the data but to sharpen the questions.”

- Samuel Karlin, 1983



Grade 5 Vocabulary Weather

Core

absorption
 altitude
 atmosphere
 atmospheric -
 (barometric) pressure
 barometer
 circulation
 condensation
 convection currents
 currents
 evaporation
 forecast
 fresh water
 front
 gas
 hydrologic (water) cycle
 latitude
 liquid
 polar regions
 precipitation
 radiation
 satellite
 sun
 temperate region
 tropical region
 vapor
 weather

Additional

absorption
 climate
 clouds
 crystallize
 distribution
 fog
 hail
 humidity
 ice
 inversion layer
 lake
 rain
 seasonal
 sleet
 snow
 tempered
 water (H₂O)
 weather balloon
 wind

Investigation & Experimentation

Grade 5

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



Grade 4

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



California Academic Content Standards:

- 4a. *Students know* uneven heating of Earth causes air movements (convection currents).
- 4b. *Students know* the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns.
- 4c. *Students know* the causes and effects of different types of severe weather.
- 4d. *Students know* how to use weather maps and data to predict local weather and know that weather forecasts depend on many variables.
- 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.
- 6b. Develop a testable question.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6d. Identify the dependent and controlled variables 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.
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- 6h. Draw conclusions from scientific evidence and indicate whether further 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.

|  | HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | |  |
|---|---|--|---|--|---|
| | RESOURCE | NOTES | RESOURCES | NOTES | |
| | <p>Chapter 1</p> <ul style="list-style-type: none"> Lesson 1, <i>What Makes Up Earth's Atmosphere?</i> pg. B 4-9 WB 66-67 Investigation Challenge, p. 7 | <ul style="list-style-type: none"> <i>A Property of Air</i>, pg. B4-5, release air from one balloon rather than popping it. | <p>Cause and Effect of Weather Patterns</p> <p>FOSS: <i>Solar Energy Investigation 2, Science Stories</i></p> <ul style="list-style-type: none"> <i>The Sun</i>, pg. 2-3 <i>Differential Heating</i>, pg. 16 – 17 <i>The Sun, the Ocean, and the Weather</i>, pg. 22 – 25 <i>Predicting Weather</i>, pg. 26 - 28 | <ul style="list-style-type: none"> Heating of Earth is uneven and the impact this has on human behavior | |





HARCOURT SCIENCE TEXTBOOK

SUPPLEMENTAL

* Resources are organized by topic



RESOURCE

NOTES

RESOURCES

NOTES

- Lesson 2, *How Are Atmospheric Conditions Measured?* pg. B10–17
- WB 70-71
- WB 72
- Graphic Organizer B1-2
- Investigation Challenge, p. B16
- *How strong is air pressure?* p. B33

Chapter 2



- Lesson 1, *What Causes Wind?* pg. B 38-43
- WB 84-85
- WB 86
- WB 87
- Lesson 2, *How Do Air Masses Affect Weather?* pg. B44 – 49
- WB 91
- Lesson 3, *What Causes Severe Storms?* pg. B50-57
- WB 92-93
- WB 95

- Focus on what causes weather; types of clouds is beyond the standard
- The uneven heating of the earth is due to the amount of atmosphere light travels through.

- Scholastic: The Wow’s and Why’s of Weather
- *Clouds and Rain*, pg. 33-34
- Blue Planet
- *Thunderclouds: Convection Currents*, pg 28 – 31
- Air Pressure**
- Investigation 2, Science Stories
- *The Pressure is On*, pg. 18 – 21.
- Scholastic: The Wow’s and Why’s of Weather
- *Balancing Balloons*, p. 12
 - *Pressure vs. Pencil*, p. 13

- Description of atmospheric pressure



|  | HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | |  |
|---|---|-------|---|-------|---|
| | RESOURCE | NOTES | RESOURCES | NOTES | |
| | <ul style="list-style-type: none"> • Activities from Home and School, pg. 61 • Science Through Time, pg. 58-59 • Performance Assessment, pg. AG 41-42 <p style="text-align: center;">Chapter 3</p> <ul style="list-style-type: none"> • Lesson 1, <i>How Can Weather Be Predicted?</i> pg. B66-73 • WB 98-99 • WB 100 • WB 101 • Lesson 2, <i>What Is Climate and How Does It Change?</i> pg B74-81 • Activities from Home and School, <i>Low Pressure</i>, p. B 85 | | <p style="text-align: center;">Weather Station Equipment</p> <p>Scholastic: The Wow's and Why's of Weather</p> <ul style="list-style-type: none"> • <i>Make a Barometer</i>, pg. 14-18 • <i>Make a Thermometer</i>, pg. 26 – 30 • <i>Anemometer</i>, p. 56 • <i>Wind Vane</i>, p. 57 • <i>Rain Gauge</i>, p. 41 | | |

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 |
|----------|---|--|
| | <ul style="list-style-type: none"> • <i>Pouring CO₂</i>, pg. 149 • <i>Crushed Can</i>, pg. 151 • <i>A Difference in Pressure</i>, pg. 154 • <i>Heat Distribution</i>, pg. 156 • <i>Convection Currents</i>, pg. 160 | <ul style="list-style-type: none"> • A demonstration showing that gases such as air have properties like liquids • A demonstration showing that air pressure exists in all directions • Differences in air pressure • Models the reason for uneven heat distribution (includes connections to mathematics) • How water or air moves due to differences in temperature |



Standards Alignment

| Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | Notes | |
|--|--|----------|----------------------------------|-------|-------|-------|-------|-------|-------|----|----|----|----|----|----|----|-------|---|
| | | | ES 3b | ES 3c | ES 4a | ES 4b | ES 4c | ES 4d | ES 4e | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i |
| Blue Planet | Thunderclouds: Convection Currents | 28-31 | | | ▼ | | ▼ | | | | | | | | ▼ | | | Does not include condensation and cloud formation but mentions this in the notes to the teacher. |
| FOSS: Solar Energy, Investigation 2: Science Stories | <i>Differential Heating</i> | 16-17 | | | ▼ | | | | | | | | | | | | | The heating of Earth is uneven and the impact of this on human behavior. Convection currents is not mentioned. |
| | <i>The Pressure is On</i> | 18-21 | | | | | | | ▼ | | | | | | | | | Description of atmospheric pressure |
| | <i>The Sun, the Ocean, and the Weather</i> | 22-23 | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | | | | | | | | | | |
| | The Sun | 2-3 | | | ▼ | | | | | | | | | | | | | |
| | <i>Predicting Weather</i> | 26-28 | | | | | | | ▼ | | | | | | | ▼ | | |
| Harcourt, Chapter 1, Lesson 1 | A Property of Air | B4-5 | | | | | | | ▼ | | | | | | | | | Activity in which students prove air has weight. If you put a small piece of tape on each balloon, then pop the balloon over the tape, the balloon will not make a loud “pop” or break into pieces. |
| | Investigate Log | WB 66-67 | | | | | | | ▼ | | | | | | | | ▼ | To be used with <i>A Property of Air</i> activity on pg. B4-5 |
| | Earth’s Atmosphere | B7 | | | | | | | ▼ | | | | | | | | | Text |

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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| Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | | | | | Notes | | |
|-------------------------------------|---|----------|----------------------------------|----------|----------|----------|----------|----------|----------|----|----|----|----|----|----|----|-------|----|---|
| | | | ES 3b | ES 3c | ES 4a | ES 4b | ES 4c | ES 4d | ES 4e | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i | |
| | Investigative Challenge: <i>A Lot of Pressure!</i> | B7 | | | | | | | ▼ | | | | | | | | | | |
| Harcourt, Chapter 1, Lesson 2 | Measuring Atmospheric Conditions | B10-11 | | | | | | | ▼ | | | | | | ▼ | ▼ | ▼ | | An activity in which students measure atmospheric conditions. |
| | Investigate Log | WB 70-71 | | | | | | | ▼ | | | | | | ▼ | ▼ | ▼ | | To be used with the activity, <i>Measuring Atmospheric Conditions</i> . |
| | Process Skills: <i>Measure and Gather Data</i> | WB 72 | | | | | | | | | | | | | ▼ | | | | |
| | Graphic Organizer: <i>Measure and Gather Data</i> | B1-2 | | | ▼ | | | | | | | | | | ▼ | | | | |
| | Weather | B12-13 | | ▼ | | | | | | | | | | | ▼ | | | | Text |
| | Air Pressure and Weather | B14 | | | | | | | ▼ | ▼ | | | | | | | | | Text |
| | Water in the Air | B15 | ▼ | ▼ | | | | ▼ | | | | | | | | | | | Text - Focus on “The Inside Story” illustration |
| | Investigation Challenge: <i>More About Air Pressure</i> | B16 | | | | | | | | ▼ | | | | | | | | | An extension of <i>A Property of Air</i> on pages B4-5 |
| | Water in the Air | B16-17 | | ▼ | | | | | | | | | | | | | | | Text - “Types of Clouds” is a foundation for content to be mastered in high school. |

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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| | | | ES 3b | ES 3c | ES 4a | ES 4b | ES 4c | ES 4d | ES 4e | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i | | |
| Harcourt, Chapter 1 | Gather Data, Measure | B3-1 | | | | | | | | | | | | | ▼ | | | | | |
| | Activities for Home or School: <i>Air Pressure</i> | B33 | | | | | | | | ▼ | | | | | | | | | | |
| Harcourt, Chapter 2, Lesson 1 | The Sun's Energy Heats Unevenly | B38-39 | | | ▼ | | | | | | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | Text does not explain uneven heating. |
| | Investigate Log | WB 84- 85 | | | ▼ | ▼ | | | | | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | ▼ | To be used with activity, <i>The Sun's Energy Heats Unevenly</i> |
| | Process Skills: <i>Predict</i> | WB 86 | | | | | | | ▼ | | | | | | | ▼ | ▼ | | | |
| | The Causes of Wind | B40-43 | | | ▼ | | | | ▼ | | | | | | | | | | | The text discusses reflection, refraction and absorption rather than the amount of atmosphere the light energy is traveling through. B41 – prevailing winds describes equatorial winds. The common misconception is that warmed air rising pulls cold air in creating a vacuum. Text implies there is one cell rather than 3 Hadley cells, although correctly shown in the illustration. |
| | Lesson Concept Review : <i>What Causes Wind?</i> | WB 87 | | | | | | | ▼ | | | | | | | | | | | Watch for regional differences such as Santa Ana winds that can lead to different answers. |
| Harcourt, Chapter 2 | Air masses and Weather | B46-49 | | | | | | ▼ | ▼ | | | | | | | | | | | Text - discuss the Sun as the primary source of energy driving all weather. |

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| | | | ES 3b | ES 3c | ES 4a | ES 4b | ES 4c | ES 4d | ES 4e | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i | |
| Chapter 2, Lesson 2 | Lesson Concept Review : <i>How Do Air Masses Affect Weather?</i> | WB 91 | | | ▼ | | | | | | | | | | | | | | Discusses reflection, refraction and absorption rather than the amount of atmosphere the light energy is traveling through. |
| Harcourt, Chapter 2, Lesson 3 | Tracking Hurricanes | B50-51 | | | | | | | | | | | | | ▼ | ▼ | | | |
| | Investigate Log | WB 92-93 | | | | | | | | | | | | | | | ▼ | | To be used with activity, <i>Tracking Hurricanes</i> |
| | Severe Storms | B52-57 | | | | | ▼ | | | | | | | | | | | | Text |
| | Predict | WB 94 | | | | | | | | | | | | | | | ▼ | | |
| | Lesson Concept Review : <i>What Causes Severe Storms?</i> | WB 95 | | | | | ▼ | | | | | | | | | | | | |
| Harcourt, Chapter 2 | Major Events in Weather Forecasting | B58-59 | | | | | | ▼ | | | | | | | | | | | Text - Observations made where likely accurate although attributed to superstition or religion |
| | Activities for Home or School: <i>Relative Wind Speed</i> | B61 | | | | | ▼ | | | | | | | | ▼ | | | | The directions may be insufficient for independent work. |
| | Relative Wind Speed | B61 | | | | | | | | | | | | | ▼ | | | | The directions may be insufficient for students to complete on their own. |
| | Assessment: <i>Tracking Hurricanes</i> | AG 41-42 | | | | | ▼ | | | | | | | | ▼ | ▼ | ▼ | | |

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| Harcourt, Chapter 3, Lesson 1 | Making a Station Model | B66-67 | | | | | | | ▼ | | | | | | | | | ▼ | An activity in which students make a weather station. Students need to know wind speed and direction symbols. Be sure to complete <i>Investigate Further</i> . | | |
| | Investigate Log | WB 98-99 | | | | | | | ▼ | | | | | | | | | ▼ | To be used with the activity, <i>Making a Station Model</i> . | | |
| | Process Skills: <i>Measure to Gather Data</i> | WB 100 | | | | | | | | | | | | | | | | ▼ | The section on uneven heating reinforces misconceptions. | | |
| | Weather Prediction | B68-69 | | | | | | | | | | | | | | | | ▼ | ▼ | Text | |
| | Weather Maps | B70-73 | | | | | | | | ▼ | | | | | | | | | | Text | |
| | How Can Weather Be Predicted? | WB 101 | | | | | | | | ▼ | | | | | | | | | ▼ | | |
| Harcourt, Chapter 3, Lesson 2 | Local Weather Conditions | B74-75 | | | | | | | | ▼ | | ▼ | | | | | | ▼ | ▼ | ▼ | This activity requires 4 weather stations. Must record data simultaneously. Be sure to implement <i>Investigate Further</i> . |
| | Investigate Log | WB102-103 | | | | | | | | | ▼ | | ▼ | | | | | ▼ | ▼ | ▼ | To be used with the activity, <i>Local Weather Conditions</i> |
| | Climates and how they change | B77-78 | | | ▼ | ▼ | | | | | | | | | | | | | | | Text |
| | Science and Technology: <i>Tracking El Niño</i> | B82-83 | | | | ▼ | | | | | | | | | | | | | | | Text |

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| | | | ES 3b | ES 3c | ES 4a | ES 4b | ES 4c | ES 4d | ES 4e | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i |
| Harcourt, Chapter 3 | People in Science: <i>Edward Lorenz</i> | B84 | | | | | | ▼ | | | | | | | | | | Text |
| | Activities for Home or School: <i>Low Pressure</i> | B85 | | | | | | | ▼ | | | | | | | | | Be sure to blow between balloons. Activity has factual errors. |
| | Assessment: <i>Predictable Weather?</i> | AG 48- 49 | | | | | | | ▼ | | | | | | | | | Requires 1 week of planning to get weather maps and 5-day forecasts from the newspapers. |
| Additional Lesson in this Guide to support the Harcourt Program | Convection Currents | <i>Guide</i> , page 160 | | | ▼ | ▼ | ▼ | | | | | | | | | | ▼ | Demonstrates temperature differences |
| | Crushed Can | <i>Guide</i> , page 151 | | | | | | | ▼ | ▼ | | | | | | | | Air pressure is exerted in all directions |
| | Heat Distribution | <i>Guide</i> , page 156 | | | ▼ | | | | | | | | | ▼ | ▼ | | | Demonstrates how energy from the sun is disbursed to set up uneven heating of the planet |
| | Pouring CO ₂ | <i>Guide</i> , page 149 | | | | | | | ▼ | ▼ | | | | | | | | Some gases have the same physical properties of liquids (once students know this, models using water to illustrate fronts makes sense). |
| | A Difference in Pressure | <i>Guide</i> , page 154 | | | | | | | | ▼ | | | | | | | | Demonstrates how differences in air pressure result in lift |
| | Piece it Together | 174-181 | ▼ | ▼ | ▼ | ▼ | | | | | | | | | | | | Students determine the climate of various regions and generalize this information based on the uneven heating of the earth. |

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| | | | ES 3b | ES 3c | ES 4a | ES 4b | ES 4c | ES 4d | ES 4e | 6b | 6c | 6d | 6e | 6f | 6g | 6h | | 6i | |
| Project WET | Poetic Precipitation | 182-185 | | | | ▼ | ▼ | ▼ | | | | | | | | | | | Students create poems on conditions that produce condensation. |
| Scholastic: The Wow's and Why's of Weather | Balancing Balloons | 12 | | | | | | | ▼ | | | | | | | | | | An activity in which students determine that air has mass |
| | Build a Weather Station: Barometer | 14, 17 | | | | | | | | | | | | ▼ | | | | | Students build a barometer using simple materials |
| | Build a Weather Station: Thermometer | 26-27 | | | | | | | | | | | | ▼ | | | | | Students build a thermometer using simple materials |
| | Build a Weather Station: Thermometer | 29-30 | | | | | | | | | | | | ▼ | | | | | Students build a thermometer using simple materials |
| | Clouds and Rain | 33-34 | | ▼ | | | | | | | | | | | | | | | Text - Focus on the water cycle |
| | Build a Weather Station: Rain Gauge | 41, 49 | | | | | | | | | | | | ▼ | | | | | Students build a rain gauge from simple materials |
| | Build a Weather Station: Anemometer | 56, 63 | | | | | | | | | | | | ▼ | | | | | Students build an anemometer using simple materials |
| | Build a Weather Station: Wind Vane | 57, 64 | | | | | | | | | | | | ▼ | | | | | Students build a wind vane using simple materials |

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

Pouring Carbon Dioxide

Science Standards

- 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.
- 6b. Develop a testable question.

Focus Concepts

- Air has mass and the force of gravity acting on that mass (weight) pulls the air toward the Earth's center.
- Students develop a question that can be tested through experimental means.

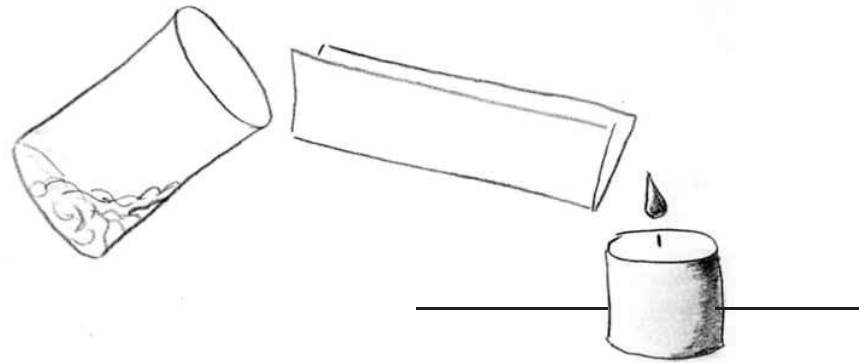
Purpose

As a basis for learning how air moves, students must understand that air, composed of gases, has many physical properties similar to liquids. By making this connection, students can use liquids to model air motion and apply their knowledge of how liquids react to anticipate the movement of air in a weather system.

Background

In Grade 5, students learn about the causes of large and small-scale movements in the atmosphere in order to build their understanding of weather system movements. To model these movements using liquid, students must know that gases and liquids move similarly.

This demonstration can be shared with students as an *inquiry lesson* in which the demonstration is performed and students are asked to determine the scientific principles that explain the phenomenon, or it can be taught through *direct instruction* as a demonstration accompanied by a discussion of the scientific principles in action.



Procedures

You will need:

- A candle
- A match (to light the candle)
- A piece of notebook paper
- Vinegar (approximately four ounces)
- Baking soda (one or two heaping tablespoons)
- Clear, high-sided cup or jar



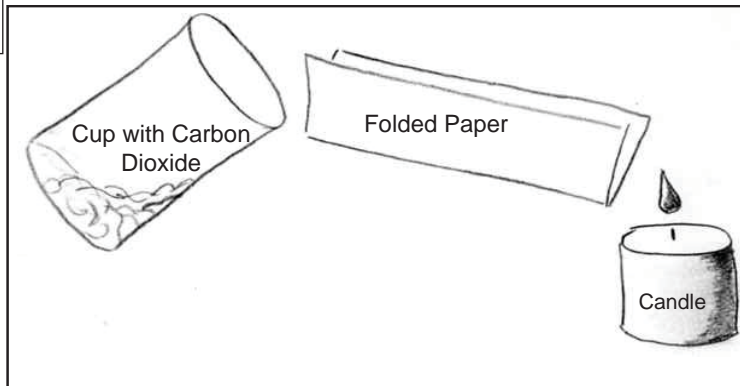
1. Ask students what they know about the physical properties of liquids (they fill the container they are in, they can be poured, etc.)
2. Ask students what they know about the physical properties of gases.
3. Ask, "Can a gas act like a liquid?" Students can develop questions that could be tested to find out if a gas could act like a liquid. One such test (this test) is whether a gas can be poured. Students can make predictions about the outcome based on their current knowledge of the properties of gases.





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

4. In the clear, high-sided cup or jar, mix vinegar and baking soda. Students will see bubbles form. Make sure the cup or jar has tall enough sides that the bubbles do not spill over the rim.
5. Allow the bubbles to subside in the cup or jar and do not move the container. This movement can mix the carbon dioxide with the air outside the container.
6. Set up a trough by folding the piece of paper into a “V”.
7. Hold the paper near the flame (as shown) at a downward angle.
8. Pour the gas from the cup into the trough and observe what happens to the flame.



Why This Works

When vinegar and baking soda are mixed in the cup, a chemical reaction takes place, as evidenced by the bubbles. The result of this reaction is carbon dioxide. Carbon dioxide is heavier than air, so it remains in the jar, even when the bubbles subside. When tipping the cup to pour the carbon dioxide, the carbon dioxide travels down the trough and spills onto the candle. By moving the oxygen out of the way, the flame is extinguished.

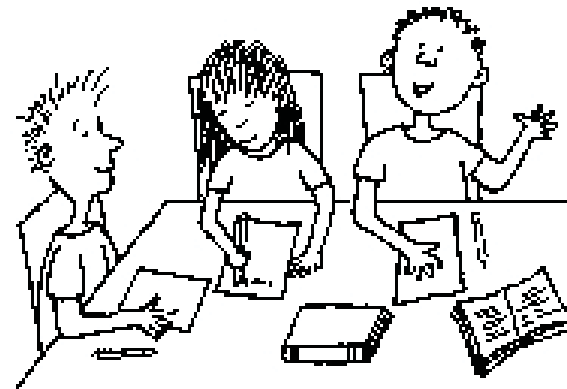
At first glance, this might look like “magic.” It is important to

explain the formation of carbon dioxide gas and why the gas can pour down the trough. By talking to students about carbon dioxide fire extinguishers, students can learn that fire needs oxygen and that carbon dioxide smothers the flame.

A common question: If carbon dioxide has oxygen in it, why can't the flame use the oxygen in carbon dioxide? The oxygen in carbon dioxide is bound to carbon, making it unavailable for flame (combustion). Extensions can include discussions about the chemical reaction between the vinegar and baking soda, as well as combustion itself.

Discussion Starters

- What do you know about the properties of air?
- Is there any difference between the properties of carbon dioxide and normal air?
- Why does oxygen support fire and carbon dioxide does not?
- How does this demonstration help you to understand the movement of air?





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

Can Crush

Science Standards

- 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.
- 6b. Develop a testable question.

Focus Concepts

- Air has mass and the force of gravity acting on that mass (weight) pulls the air toward the Earth’s center.
- Students develop a question that can be tested through experimental means.

Purpose

This demonstration shows that air pressure is a “pushing” force that acts on an object from all directions equally.

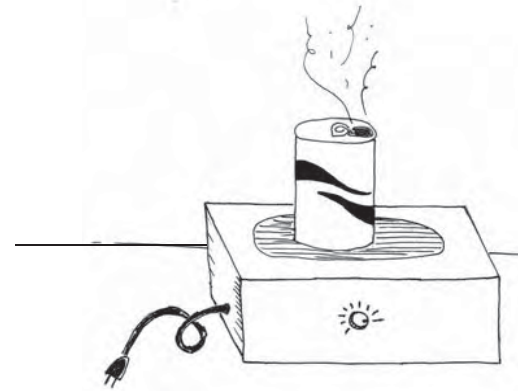
Background

In Grade 5, students learn about the causes of large and small-scale movements in the atmosphere in order to better understand weather. Atmospheric pressure is the weight of air pushing on a given square unit area. This “pushing” is from all directions equally – up, down, and sideways. In many text resources, air pressure is illustrated by a column of air from the surface of the planet to the outer reaches of the atmosphere. This misleads students into thinking that air pressure is only a downward force because of the weight of air above.

BACKGROUND READING



This demonstration can be shared with students as an *inquiry lesson* in which the demonstration is performed and students are asked to determine the scientific principles that explain the phenomenon, or



it can be taught through *direct instruction* as a demonstration accompanied by a discussion of the scientific principles in action.

Procedures

You will need::

- Hot plate
- Tongs
- Water
- Empty aluminum soda can
- Container / dump bucket with water in it



Part 1

Crushing the Can Demonstration (time to teach: 20 minutes)

1. Ask students what they know about air pressure.
2. Ask students how they might prove that air pressure exists. Students can create testable questions. One such question is what would happen if the air pressure inside a container and outside a container were different.





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

3. Show students an “empty” aluminum can. Ask them, “Is this can empty? How do you know?” The can has air in it. If the can were truly empty, would it retain its shape?
4. Put about 1/8 cup of water into an open aluminum can.
5. Put the aluminum can on the hot plate. Allow the water to boil in the can until you can see a good quantity of steam exiting the can.
6. Pick up the can using the tongs. Quickly turn the can upside down into the dump bucket, just submerging the can opening. When the can is put into the dump bucket, there will be a “pop” as the can crushes.
7. Show the students the crushed can. Ask them to explain why the can crushed.

Why This Works

When on the hotplate, the water boils, becoming water vapor. The water vapor displaces the air. When the can is turned upside down into the waste bucket, the water vapor inside the can condenses, taking up less space than it did as a gas. Since the opening of the can is under water, air cannot enter the can. The air pressure outside the can is now significantly greater than the water vapor pressure inside the can. Although water is forced into the can by air pressure, it cannot flow in fast enough before the can collapses from the equal air pressure on all sides of the can from the outside.

Discussion Starters

- Why is it harder to breathe at the top of a mountain than at sea level?
- Why doesn't my body crush (like the can does) when I exhale?
- What happens to the water in the can that allows this phenomenon to happen?

Part 2

Air Pressure, An Activity for Students (time to teach: 20 minutes)

What you need (for each student):

Index card
Cup
Water

1. If the aluminum can is crushed, from a difference in pressure between the inside and outside of the can, how else can we show that air pressure exerts a force on all sides of a container?
2. Give each student a cup with water in it and an index card.
3. Have students put the index card over the top of the cup and hold the index card in place with their hands (Figure 1).
4. Invert the cup with the index card (Figure 2).
5. Students remove their hand from the index card.
6. Have students explain what happens.

Figure 1

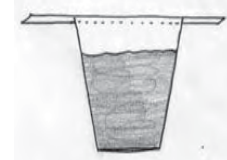
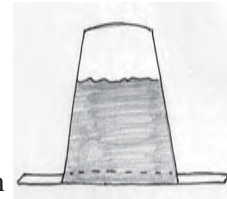


Figure 2



Why This Works

Air pressure exerts an equal force on all sides of the cup, including from beneath. When the students remove their hands from the index card, air pressure is keeping the card against the mouth of the cup. If the index card becomes saturated, the seal will be broken, air will enter the cup, water will spill from the cup, and the card will fall. If you use a plastic card instead of paper, the card and cup can remain inverted indefinitely. You can prove this by hanging the cup somewhere in the classroom (but not over anything that could not afford to get wet!).

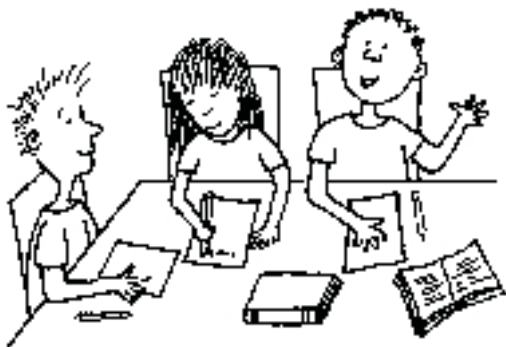




This sample instructional activity illustrates possible strategies for accessing the content within the standards.

Discussion Starters

- Why did the index card stay on the cup when the cup was inverted?
- Could any material be used to replace the index card? What would be better / worse and why?
- Once the cup is inverted, what would happen if I moved the index card?
- How long can this system be maintained? (By attaching a ring to the bottom of the cup, students can hang their inverted cups to test this question.)





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

A Difference in Pressure

Science Standards

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.

Focus Concepts

- 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.

Purpose

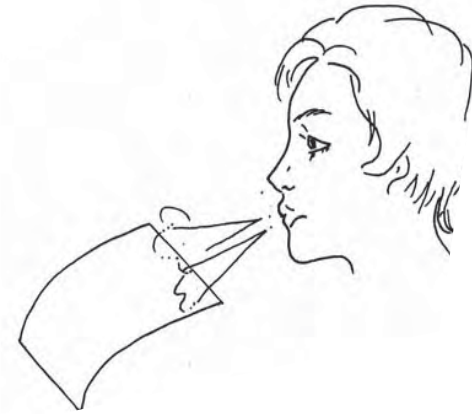
A difference in air pressure can create lift. When air pressure is reduced over the surface of an object, by adding energy to the system or due to a temperature differential, the air pressure beneath the object will lift the object.

Background

A difference in air pressure can be made visible through the following activities.

In an atomizer, or perfume sprayer, you squeeze a rubber bulb to squirt air through a tube. The air rushing through the tube has a lower pressure than the surrounding atmosphere. Atmospheric pressure forces the perfume up an intersecting tube into the low-pressure airstream. The perfume is pushed out of the tube and sprays into the air as a fine mist.

The air rushing through the space between two moving trains also has a lower pressure, as explained by the Bernoulli principle. Sometimes, the higher pressure, stationary air inside each train forces some of the trains’ windows out of their frames.



When air is pushed over the wing of a plane, the shape of the wing creates a difference in pressure so that there is less pressure on the top of the wing than on the bottom of the wing. When this happens, the airplane wing is pushed upward.

Part 1

Bernoulli’s Principle (Time to teach: 20 minutes)

Procedures

You will need: A piece of paper

1. Hold a piece of paper in front of you as shown.
2. Blow down on the piece of paper.
3. Discuss what happens to the piece of paper.



Why This Works

When you blow down on one side of the piece of paper, the air flows over the surface of the paper. The faster moving air over the top of the paper results in a decrease in air pressure over the top of the paper. The pressure under the paper pushes the paper up, just as an airplane wing gets “lift” by increasing the speed of air over the top of its wings.





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

Discussion Starters

- How does the speed of the air passing over the paper affect the air pressure?
- How does the movement of a shower curtain in a hot shower mirror the movement of the paper?



Part 2 A Challenging Demonstration of Bernoulli's Principle (time to teach: 20 minutes)

Procedures

What You Need:

A large wood or plastic thread spool
 An index card
 Optional: Drinking straws, A pushpin or needle



1. Trim an index card to a 3 x 3 inch (7.5 x 7.5 cm) square.
2. Push the pushpin or needle into the card's center (to keep the card from moving sideways).
3. If more than one person is going to use this, construct the following sanitary version: Cut a 2 inch (5 cm) long piece of straw for each person. At each person's turn, have him or her push one end of the straw into the hole in



the spool. If any straw does not fit, cut a 1/2 inch (6.25 mm) slit near the end of the straw and push it into the spool.

4. Hold the card against the bottom of the spool with the pushpin sticking into the hole at the center of the spool. The pushpin keeps the card from drifting off to the side.
5. Blow strongly through the hole in the top of the spool and let go of the card. If the card falls at first, experiment with different sized cards or spools until you can make the card hang suspended beneath the spool.

Why This Works

When you blow into the spool, the air goes through the opening, hits the card, and accelerates outward. The energy needed to accelerate the air comes from the student as they blow through the spool or straw. As air (or any other fluid) accelerates, its pressure drops. This is known as the Bernoulli principle. The air rushing between the spool and the card exerts less pressure on the card than the still air underneath the card. The still air pushes the card toward the spool and holds the card up against gravity.

Discussion Starters

- How does this demonstration relate to weather fronts?
- Why do you think you have to blow so hard through the straw to make the effect happen?

Sources Used in Developing This Lesson

San Francisco Exploratorium, *Bernoulli Levitator*





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

Earth's Uneven Heat Distribution

Science Standards

- 4a. *Students know* uneven heating of Earth causes air movements (convection currents).
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.

Math Standards

MG Standard Set 2.0: Students identify, describe, and classify the properties of, and the relationships between, plane and solid geometric figures:

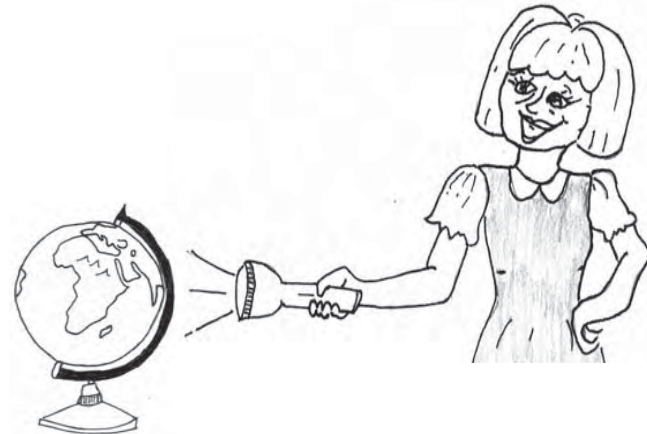
- 2.1 Measure, identify, and draw angles, perpendicular and parallel lines, rectangles, and triangles by using appropriate tools (e.g., straightedge, ruler, compass, protractor, drawing software).

SDAP Standard Set 1.0: Students display, analyze, compare, and interpret different data sets, including data sets of different sizes:

- 1.3 Use fractions and percentages to compare data sets of different sizes.

Focus Concepts

- The atmosphere and surface of Earth are heated unevenly.
- Students make quantitative observations.
- Students record data using graphic representations.



- Students use graphically represented data to make reasonable inferences.

Purpose

To show how energy entering the Earth's system from the Sun is distributed over the surface area of land based on the relationship between the Earth and the direction of the Sun's rays.

Background

In Grade 5, students learn the atmosphere and surface of Earth are heated unevenly, giving rise to both local and global temperature differences. As explained in the *California Science Framework*, the direct heat absorbed by the surface of the ocean, land, and air in different locations may result in different temperatures. The amount of heat varies with latitude, primarily because of the angle of the Sun in the sky. The lower the Sun's elevation, the less direct is its radiation with less radiation falling on each square meter of Earth's surface area (because the same amount of radiation is spread over a larger area). This is a result of geometry and depends on





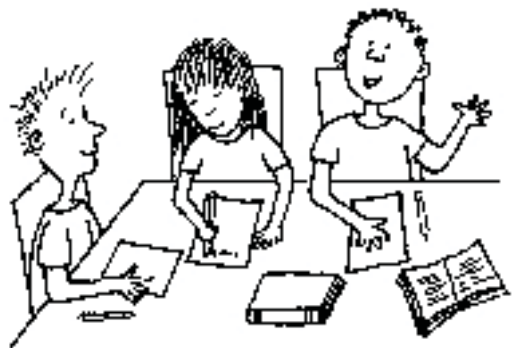
This sample instructional activity illustrates possible strategies for accessing the content within the standards.

the angle at which the Sun's rays intersect Earth's surface at a locality. Polar regions are cold because the Sun's rays fall to the Earth at acute angles. Closer to the equator, the Sun's rays are more perpendicular and the climate is hot. The uneven heating results in local and global temperature differences that create convection currents in the oceans and atmosphere.

This short activity can be done by cooperative groups of students and then used as a concrete experience from which a discussion on the uneven heating of the Earth emerges. If used as a cooperative activity, each group of students should be provided with the following sheet of directions and each student should have a copy of the data sheet.

Discussion Starters

- Why do you think the heat of the Sun is being distributed unevenly?
- Why is it warmer at the equator than at the poles?
- How does this demonstration help you predict the location of deserts, forests, and tundras globally?



Name: _____

Earth's Uneven Heat Distribution

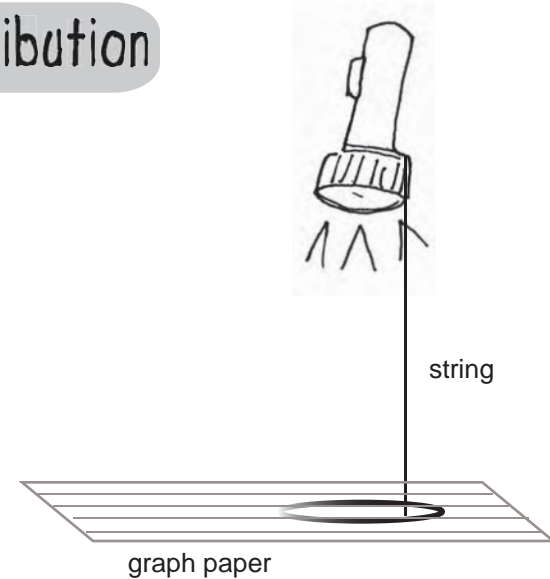
What you need:

- Flashlight
- Graph paper
- Scissors
- String
- Tape
- Protractor

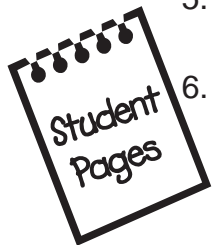


Procedures:

1. Since flashlights will have a different intensity based on their size and batteries, test the flashlight to determine the distance between the paper and instrument to create a pool of light approximately 6cm in diameter.
2. Cut a piece of string to represent the distance between the flashlight and the table surface.
3. Tape one end of the string to the end of the flashlight, the other to the graph paper (see picture).
4. Hold the flashlight perpendicular to the graph paper (90-degree angle) so that the string is firmly stretched to the surface of the graph paper. Use the protractor to help you with exact angles.
5. Record the number of squares on the graph paper that are illuminated by the flashlight.
6. Hold the flashlight at a 60-degree angle to the surface of the graph paper.



7. Record the number of squares on the graph paper that are illuminated by the flashlight.
8. Hold the flashlight at a 30-degree angle to the surface of the graph paper.
9. Record the number of squares on the graph paper that are illuminated by the flashlight.
10. For each of your measurements, determine the fractional or percentage ratio of illuminated surface area.



Name: _____

Record Your Data

Create a chart to record your data:

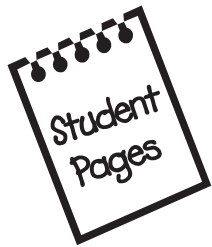
1. What does the flashlight represent?

2. What do each of the three measurements (90-degrees, 60-degrees, and 30-degrees) represent?

3. How could you make measurements that would reflect a more accurate model of the uneven heating of the Earth?

4. How does this activity model uneven heat distribution of the Earth?"

5. Illustrate (using a diagram) the relationship between the Sun's energy and the Earth's surface.





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

Convection Currents

Science Standards

- 4a. *Students know* uneven heating of Earth causes air movements (convection currents).
- 4b. *Students know* the influence that the ocean has on the weather and the role that the water cycle plays in weather patterns.
- 4c. *Students know* the causes and effects of different types of severe weather.
- 6h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.

Focus Concepts

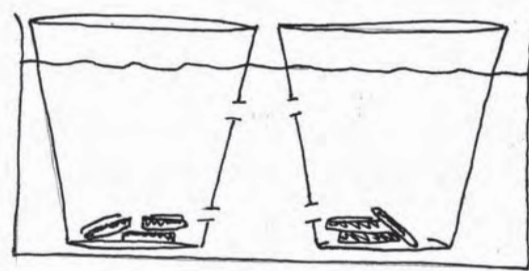
- The atmosphere and surface of Earth are heated unevenly. Uneven heating results in local and global pressure and temperature differences.
- The transportation of heat and water globally by oceans (oceanic circulation) moderates global temperatures.
- When air masses of different temperatures meet, 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.
- Students draw conclusions from scientific evidence

Purpose

To model a temperature gradient between two fluid masses.

Background

In Grade 5, students learn the atmosphere and surface of Earth



are heated unevenly, giving rise to both local and global temperature differences. As explained in the *California Science Framework*, this uneven heating results in local and global temperature differences that create convection currents in the oceans and atmosphere.

This activity can be done by students in small cooperative groups, or using one large aquarium as a demonstration. If completed by groups of students, follow the activity with a conversation on how this model of convection currents relates to the distribution of heat energy in the oceans and atmosphere.

Preparation

This activity will require that you have ice. You can make cold, blue ice water by adding food coloring to ice water, or adding blue food coloring to water before freezing it to create colored ice. Water can be frozen in snack-sized zip-lock bags creating a single “zip-lock size” piece of ice (small ice cubes also work well).

Discussion Starters

1. Which dissipates faster, hot or cold water?
2. How does this model illustrate the movement of air masses of different temperature?
3. Other than air masses, where else might you see convection currents?



Name: _____

Convection Currents

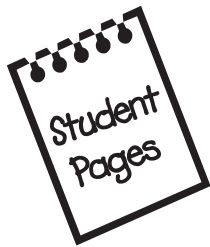
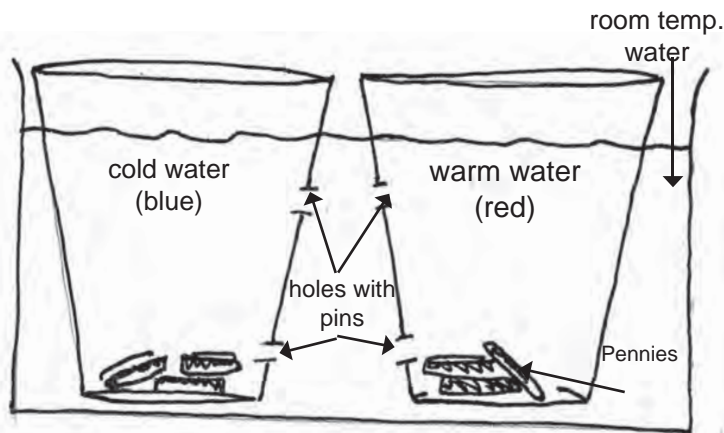
What you need:

- Clear shoe box or similar sized container
- nails or pushpins
- Water
- pennies (or other weight)
- 2 clear cups
- ice
- food coloring (red and blue)



Procedures:

1. Create two holes in each plastic cup, one hole near the top of the cup and one hole near the bottom of the cup's side. The holes in the cups should be below the surface of the larger container. Keep the nails or pushpins in the holes.
2. Place the cups and pennies (or other weights) in the plastic shoebox as shown.



3. Predict what will happen to the cold and hot water when the nails are removed?

4. Add room temperature water to the plastic shoebox.
5. Mix (red) food coloring with hot water and pour it into one cup.
6. Use your blue ice cubes, or mix (blue) food coloring with ice to make very cold water.
7. Remove the pins or nails from the cups.
8. Watch carefully as the water moves from the cups into the larger container. (You may put a piece of white paper behind your container to make it easier to see the movement of colored water.) Record your observations:





Solar System

Introduction

The *Solar System* unit is focused on the composition of the solar system that includes small bodies, such as asteroids and comets, as well as the Sun, the nine planets, and their moons. This builds on learning in Grade 3 that the Earth orbits the Sun and the Moon orbits the Earth. Students learn the basic relationship between gravity and the planetary orbits that will be developed later in more depth in Grade 8.

The most challenging concept within this unit is for students to understand *gravitational attraction* as evidenced by the relatively circular orbit of the Moon around the Earth, the planets around the Sun, and the more elliptical orbits of comets and asteroids around the Sun. Objects in the solar system would travel in straight lines if they were not pulled or pushed by a force (gravity).

Across Los Angeles there are many resources to support an enriched study of our solar system. The city’s museums, aerospace, planetary societies, and defense contractors have a wide variety of resources, curricula, and field trip opportunities that focus on the objects in our solar system and the role of gravity. Government-supported websites such as NASA provide exceptional resources reflecting current explorations into space. 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 standards 6a, 6c, 6f – 6i.

California Academic Content Standards:
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.
- 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.
- 5c. *Students know* the path of a planet around the Sun is due to the gravitational attraction between the Sun and the planet.
- 6a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- 6h. Draw conclusions from scientific evidence and indicate whether further 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.

Vocabulary –The core vocabulary for the *Solar System* unit focuses on the objects in our solar system and the forces acting on these objects. Additional vocabulary reflects terminology students may have been introduced to in Grade 3, and terms they will become familiar with as a result of activities within this unit. The key terminology for I&E Grades 4 and 5 are provided as a reference.

Additional Lessons — If using the *Harcourt Science* program, the resources listed provide a foundational access to the content





standards in this unit and therefore no additional lessons are necessary.

Critical Questions

- What is the central body in our solar system and what does it use to generate energy?
- What are the major objects within our solar system?
- How are circular and elliptical orbits formed?



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: There are a number of fascinating pieces of literature about those who have studied the solar system. Some are biographical, and others fanciful. Students can examine literature, poetry, and multi-media on the wonder of our place in the galaxy.

Mathematics: There are a number of activities in which students can practice measurement and ratio as extensions of the content within this unit. Interesting stories about the importance of properly calculating standard to metric measurement can be found in previous NASA missions.

History-Social Science: The study of the solar system connects with the exploration and endeavors of the United States into space. Students may be interested with the history of the space program and how scientific advancements in this area have translated into technological advances in our everyday lives.

Health: Students can learn about the scientific experiments

taking place in space designed to better understand the role of gravity on the human body, and the challenges of living in space.

Background

In Grade 5, students should know that there is a force called gravity, and it is responsible for the attraction between objects, both in space and on Earth. Students will learn the role of mass and gravity in forming the planets, stars, and solar system in Grade 8 (standards 2a – g).

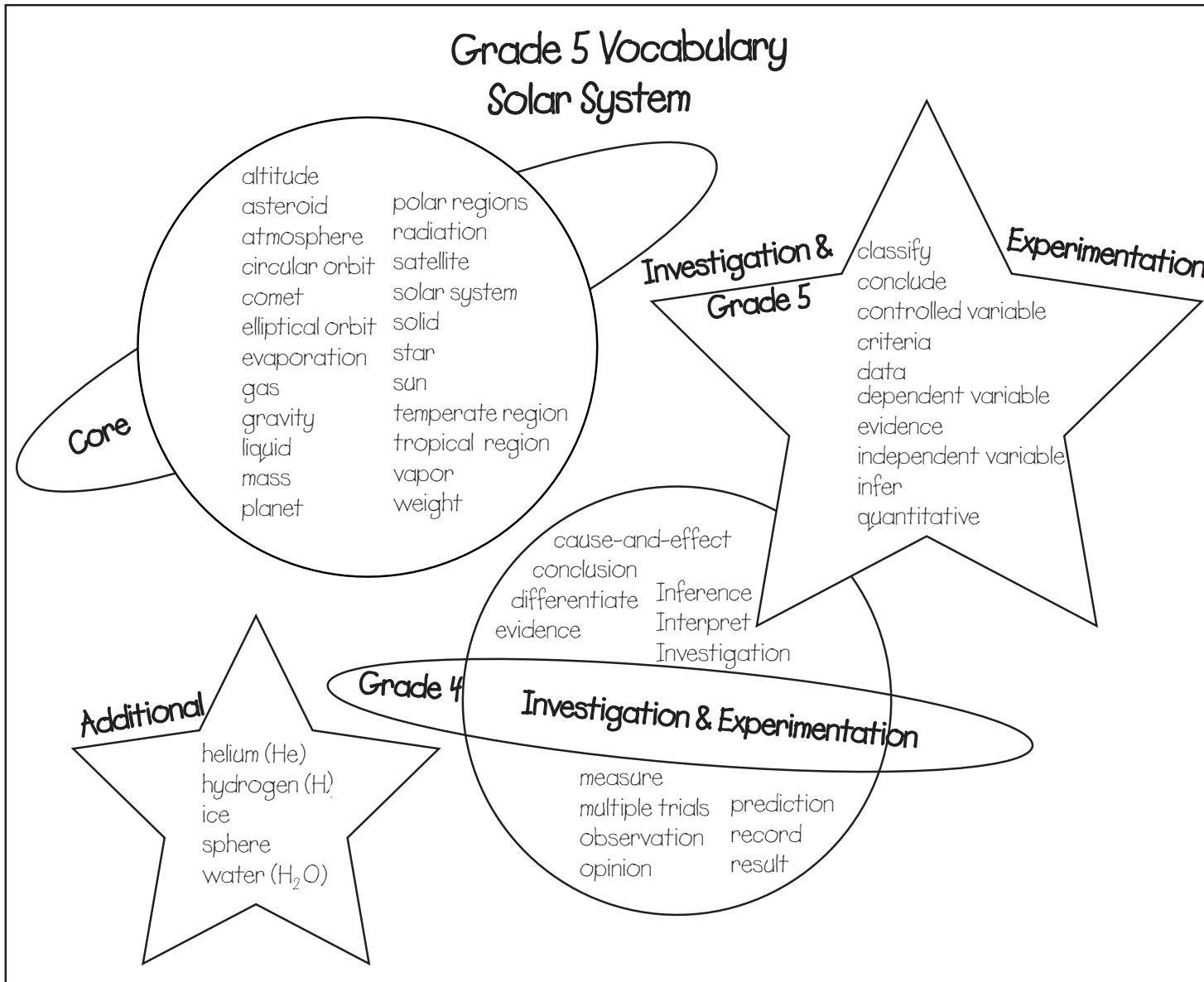
- Although students may have seen pictures of astronauts in space who appear to be free from gravity, it is because of the speed and direction in which the astronauts are traveling. For those who have heard about “zero-gravity” or “micro-gravity” environments, many of these are simulations in which air resistance is removed and people and objects are falling at the same rate of speed to give the appearance of the lack of gravity.
- Standard 5a introduces students to the composition of the Sun. Although they learn that the Sun is composed of hydrogen (H) and helium (He), and that energy from the Sun results from a nuclear reaction between these elements (fusion), a deeper understanding of how this occurs will come in Grade 8 with the study of atomic mass.
- Whether students have studied the Grade 5 physical science module prior to this unit or not, elements are provided with their symbolic representations to support learning about, and becoming comfortable with, the language of science, including symbols found on the Periodic Table.

“Astronomers always work in the past; because light takes time to move from one place to another, they see things as they were, not as they are.”

- Neale E. Howard, The Telescope Handbook and Star Atlas (1967)





Grade 5 Vocabulary Solar System





California Academic Content Standards:

- 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.
- 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..
- 5c. *Students know* the path of a planet around the Sun is due to the gravitational attraction between the Sun and the planet.
- 6a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
- 6c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- 6f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- 6g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- 6h. Draw conclusions from scientific evidence and indicate whether further 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.

| My notes  | HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | | My notes  |
|---|--|---|--|-------|---|
| | RESOURCE | NOTES | RESOURCES | NOTES | |
| | <p>Chapter 4</p> <ul style="list-style-type: none"> Lesson 1, <i>How Do Earth and the Moon Compare?</i> pg. B90 – 97 WB 108 – 109 Lesson 2, <i>How Have People Explored Space?</i> pg. B98 - 105 | <ul style="list-style-type: none"> Focus on circular vs. elliptical orbits. Focus on the tools developed to help scientists explore the objects in the night sky. | <p>The Sun and Solar System</p> <p>FOSS: <i>Solar Energy</i> Investigation 1, <u>Science Stories</u></p> <ul style="list-style-type: none"> <i>The Sun</i>, pg. 1-5 <p>Investigation 4, <u>Science Stories</u></p> <ul style="list-style-type: none"> <i>Living with a Star</i>, pg. 40 - 44 <p>The Path of Planets in our Solar System</p> <p>FOSS – <i>Solar Energy</i></p> <ul style="list-style-type: none"> <i>Living with a Star</i>, pg. 43-44 | | |



| My notes  | HARCOURT SCIENCE TEXTBOOK | | SUPPLEMENTAL * Resources are organized by topic | | My notes  |
|---|--|---|--|---|---|
| | RESOURCE | NOTES | RESOURCES | NOTES | |
| | <p>Chapter 5</p> <ul style="list-style-type: none"> Lesson 1, <i>What Are the Features of the Sun?</i> pg. B114 – 121 Lesson 2, <i>What Are the Planets Like?</i> pg. B122 - 129 Lesson 3, <i>Why Do the Planets Stay in Orbit?</i> pg. B130 – 135 WB 126 – 127 WB 129 WB 130 | <ul style="list-style-type: none"> Some of the lesson introduces content to be mastered in Grade 6: 4a, 4b, 4c. De-emphasize wave theory and parts of the sun. Emphasize information about the planets, not the distance between them. Include “Investigate Further” section | <p>Science Fair Projects: Flight, Space & Astronomy</p> <ul style="list-style-type: none"> Project 29, <i>Once Around the Sun</i>, pg. 50-51. Project 42, <i>Pedal Power</i>, pg. 71 | <ul style="list-style-type: none"> Connections to mathematics (how long is a year on each planet based on the length of its orbit) Connections to mathematics (distance from earth to the moon) | |



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| Source | Description | Pages | Standards Supported in this Unit | | | | | | | | | | Notes |
|-------------------------------|--|------------|----------------------------------|----------|----------|----------|----|----|----|----|----|----|---|
| | | | ES 4a | ES 5a | ES 5b | ES 5c | 6a | 6c | 6f | 6g | 6h | 6i | |
| FOSS: Solar Energy | Investigation 4 – Science Stories: <i>Living with a Star</i> | 40-44 | | ▼ | ▼ | ▼ | | | | | | | |
| | Investigation 2 – Science Stories: <i>The Sun</i> | 1-5 | ▼ | ▼ | | | | | | | | | |
| Harcourt, Chapter 4, Lesson 1 | How Earth, the Moon, and the Sun Move Through Space | B90-91 | | | | ▼ | | | | | | | An activity that models the path of planets, but not gravitational attraction |
| | Investigate Log | WB 108-109 | | | | ▼ | | | | | | | To be used with activity on B90-91 |
| | Earth and Moon in Space | B92-93 | | ▼ | ▼ | ▼ | | | | | | | Focus on how the Earth and moon move in space. |
| Harcourt, Chapter 4, Lesson 2 | Space Exploration | B100-101 | | | ▼ | | | | | ▼ | | | Text - Examine the timeline with the focus on the role of the telescope and other tools of space exploration. |
| Harcourt, Chapter 5, Lesson 1 | The Sun | B116-117 | | ▼ | | | | | | | | | Text – the discussion of wave theory and light rays is for mastery in Grade 7: 6a |
| | Exploring the Sun | B118 | | ▼ | | | | | | | | | Text – discuss that the sun is an average star and is made of hydrogen and helium |
| | Investigative Challenge: <i>Modeling Convection</i> | B119 | ▼ | | | | | | | | | | This activity may not work. |
| Harcourt, Chapter 5, Lesson 2 | The Planets | B124 | | | | ▼ | | | | | | | Aligned with diagram only |
| | The Planets | B124-129 | | | ▼ | | | | | | | | 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 5a | ES 5b | ES 5c | 6a | 6c | 6f | 6g | 6h | 6i | |
| Harcourt, Chapter 5, Lesson 3 | Orbits | B130-131 | | | | ▼ | | ▼ | ▼ | ▼ | ▼ | ▼ | Without explaining centripetal acceleration, this activity can lead to some misconceptions. Best used as a demonstration due to safety. Be sure to complete the Investigate Further section for alignment with standards 6f, 6g, 6h and 6i. |
| | Investigate Log | WB 126-127 | | | | ▼ | | ▼ | ▼ | ▼ | ▼ | ▼ | To be used with activity, <i>Orbits</i> . Aligned with 6c, 6f, 6g, 6h and 6i if <i>Investigate Further</i> section is completed. |
| | The Orbits of Planets and Moons | B132-135 | | | | ▼ | | | | | | | Text |
| | Lesson Concept Review: <i>Why Do the Planets Stay in Orbit?</i> | WB 129 | | | | ▼ | | | | | | | |
| Science Fair Projects: Flight, Space & Astronomy | Project 29, Once Around the Sun | 50-51 | | | | ▼ | ▼ | | | ▼ | | | Math connections: how long is a year on each planet based on the length of each planet's orbit |
| | Project 42, Pedal Power | 71 | | | | ▼ | | | | ▼ | | | Math connections: distance from the Earth to the Moon |

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



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

Developed based on design by Diana Roston, LAUSD teacher.

Module Planning Calendar

| | | | | | | | |
|------------------------|--------------------------------|-----------------------|-------------|------------------------|--------------------------------|-----------------------|------------|
| 5 | Unit of Instruction: | Selected Resource(s): | Assessment: | 6 | Unit of Instruction: | Selected Resource(s): | Assesment: |
| 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 | | | |

Developed based on design by Diana Roston, LAUSD teacher.

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

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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.

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s****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

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.

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 lightning 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.

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

Grade 4 - Life Science Content Standards

Key Knowledge and Concepts from the California Science Framework

| | |
|---|--|
| <p>2a. Students know plants are the primary source of matter and energy entering most food chains.</p> | <ul style="list-style-type: none"> Organisms need energy to live and grow. Plants harness energy from the sun and are the primary source of energy entering most food chains. A food chain is a representation of the flow of energy and matter from organism to organism by consumption. |
| <p>2b. Students know producers and consumers (herbivores, carnivores, omnivores, and decomposers) are related in food chains and food webs and may compete with each other for resources in an ecosystem.</p> | <ul style="list-style-type: none"> Students can identify and distinguish between consumers, producers, and decomposers in food chains. Consumers can be herbivores, carnivores, omnivores, or decomposers. Producers and consumers may compete for resources in an ecosystem (food webs). |
| <p>2c. Students know decomposers, including many fungi, insects, and microorganisms, recycle matter from dead plants and animals.</p> | <ul style="list-style-type: none"> Decomposers recycle matter from dead plants and animals. Many fungi, insects, and microorganisms are decomposers. |
| <p>3a. Students know ecosystems can be characterized by their living and nonliving components.</p> | <ul style="list-style-type: none"> Living organisms depend on their environment for survival. Each ecosystem can be described by its components as well as the characteristics of the organisms living within it. Ecosystems are characterized by their living (biotic) and nonliving (abiotic) components. |
| <p>3b. Students know that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.</p> | <ul style="list-style-type: none"> An organism's survival is directly affected by the environment it inhabits. Some organisms have <i>accommodations</i> to increase their chance of survival; some species have <i>adaptations</i> to increase their chance of survival. |
| <p>3c. Students know many plants depend on animals for pollination and seed dispersal, and animals depend on plants for food and shelter.</p> | <ul style="list-style-type: none"> Some animals help plants in pollination and seed dispersal. Animals depend on plants for food and shelter. |
| <p>3d. Students know that most microorganisms do not cause disease and that many are beneficial.</p> | <ul style="list-style-type: none"> Most microorganisms are beneficial, acting as the foundation of many food chains and food webs. Some microorganisms cause disease or act as decomposers in ecosystems. |

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s****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 Life Science Vocabulary

Additional

consume
deposit
direct
entangle
evolution
flow
harmful
indirect
nutrients
parent plant
primary consumer
relationships
recycle
resources
seasonal diet
secondary consumer
seed caches
seed pods
sustain
visible

Core

| | |
|---------------|----------------|
| abiotic | food web |
| accommodation | fungi |
| adaptation | herbivore |
| beneficial | matter |
| biological | microorganism |
| biomes | omnivore |
| biotic | organism |
| carnivore | pollination |
| competition | predator |
| consumer | prey |
| decomposer | producer |
| disease | remains |
| ecosystem | seed dispersal |
| energy | shelter |
| environment | solar energy |
| food chain | waste |

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

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

abiotic - Non-living things within an environment and that are not products of living things (water, sunlight, etc.).

accommodation - Changes made by an individual organism to increase its chance of survival.

adaptation - A body part or behavior, developed over generations, that helps populations of organisms better meet their needs in their environment.

beneficial - Producing a good or advantageous effect.

biological - Relating to living organisms.

biomes - Similar or related environments that may contain multiple ecosystems.

biotic - Living things or products of living things within an environment (organisms, decaying materials, etc.).

carnivore - An animal that feeds mainly on other animals.

competition - The struggle between organisms for limited resources such as food or light.

consumer - Organisms that get their energy by eating other organisms (plants or animals).

decomposer - Organisms that break down or feed on the tissues of dead organisms.

disease - A condition in plants or animals that causes medically significant symptoms.

ecosystem - The interaction of a community of organisms and its physical environment.

energy - The ability to cause a change.

environment - Everything that surrounds and affects an organism, including living and nonliving things.

food chain - An organizational model showing how organisms in an ecosystem are connected based on what they eat.

food web - An organizational model showing the competition for food within an ecosystem.

fungi - Plant like organisms that reproduce by spores and live by absorbing nutrients from organic materials.

herbivore - An animal that feeds mainly on grass and other plants.

matter - Anything that has mass and takes up space.

microorganism - A plant or animal that is so small that a microscope is needed to see it.

omnivore - An organism that feeds on both plants and other animals.

organism - A living thing.

pollination - The process of plant fertilization.

predator - An organism that survives by catching and eating animals.

prey - An animal that is caught, killed, and eaten by another organism.

producer - Organisms that use solar or chemical energy to make the food they need.

remains - All that is left of something.

seed dispersal - The method of distribution or scattering of seeds over an area in order for plants to increase the size of the area they cover.

shelter - A place where organisms are protected from other organisms or from the weather.

solar energy - Energy originating from the Sun.

waste - Something that is no longer useful.

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s****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.

| K | Grade 4 - Science Content Standards Investigation and Experimentation | Key Knowledge and Concepts from the California Science Framework |
|---------------------------------|---|--|
| e y | 6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations. | <ul style="list-style-type: none"> • Students can differentiate between observation and inference. • Explanations come from observations and the interpretation of observations. |
| k n o w i d e | 6b. Measure and estimate the weight, length, or volume of objects. | <ul style="list-style-type: none"> • Students know what weight, length, and volume represent. • Students know how to measure and estimate the weight, volume, and length of objects. |
| g e | 6c. Formulate and justify predictions based on cause-and-effect relationships. | <ul style="list-style-type: none"> • Students know what cause-and-effect relationships are. • Students can make and justify predictions using cause-and-effect principles. |
| a n d | 6d. Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results. | <ul style="list-style-type: none"> • 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. |
| C o n c | 6e. Construct and interpret graphs from measurements. | <ul style="list-style-type: none"> • Students can use measurements to construct a graph. • Students can interpret graphs. |
| e p t s | 6f. Follow a set of written instructions for a scientific investigation. | <ul style="list-style-type: none"> • Students can follow a set of written instructions to perform a scientific investigation. |

Grade 4 Earth Science Vocabulary

Additional

agent
alternate
alter
carbon dioxide (CO₂)
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

Grade 4 Investigation & Experimentation

Names of Common Minerals

calcite
feldspar
galena
hematite
hornblende
mica
quartz

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

Size Terms

boulder
cobble
pebble
sand
silt
clay

Grade 5

Investigation & Experimentation

Properties of Rocks & Minerals

cleavage
hardness
luster
metallic
non-metallic
streak

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

Core Vocabulary - Defined

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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.

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 fine-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.