OFFICE OF CURRICULUM, INSTRUCTION, & PROFESSIONAL DEVELOPMENT

HIGH SCHOOL COURSE OUTLINE

(Revised January 2011)

Department	Science	**Course Title**	Laboratory Earth Science 1-2	**Course Code**	4009				
Grade Level	9-12	**Short Title**	EARTH SCI LAB 1-2	**Grad Requirement**	Yes				
Course Length	2 semesters	Credits per Semester	5	Approved for Honors	No	Required	X	Elective	
Prerequisites	Previous science and Algebra 1-2 or CD (can be concurrent) with a "C" or better, or science teacher recommendation								
Co-requisites	None								
Articulated with LBCC	No	Articulated with CSULB	No						
Meets UC “a-g” Requirement	Yes (g)	Meets NCAA Requirement	Yes						

COURSE DESCRIPTION:

Laboratory Earth Science 1-2 is laboratory-based approach to the California high school Earth Science Content Standards. Students should spend approximately fifty percent (50%) of their class time engaged in investigative activities. Introductory principles of astronomy and Earth sciences will be explored in detail, including the solar system, cosmology, plate tectonics, energy, biogeochemical cycles, the atmosphere, and California geology. Students will evaluate evidence from experiments and technology used by scientists to understand the nature of the universe and the Earth. They will also explore how basic interactions of matter and energy control global activity in the atmosphere, hydrosphere, lithosphere, and biosphere. Constructivist methods of teaching are employed to ensure the best possible comprehension and retention of science concepts. Science activities will be based on the California Science Content Standards as delineated in the California Science Framework and will apply the skills and techniques outlined in the Investigation and Experimentation Strand of the Content Standards. Successful completion of one year of Laboratory Earth Science 1-2 meets the high school graduation requirement for physical sciences and fulfills the UC/CSU “g” elective requirement. A course in the life sciences is also needed to complete the minimum graduation requirement for high school.

COURSE PURPOSE: GOALS (Student needs the course is intended to meet)

CONTENT
- Students will learn all of the required California State Standards for Earth sciences. They will explore the structures, processes, and the current models of cosmological history related to our universe and solar system. Students will also investigate the dynamics and structures of Earth, including both external and internal energy sources and their influence on geographical, atmospheric, and ecological features and cycles. Applications of these concepts will also be made to the unique features, hazards, and resources of California.

SKILLS
- Students will apply measurement, observation, statistical, and technological skills while investigating astronomic, geologic, atmospheric, and resource concepts. Evidence and experimental data will be analyzed for reliability and possible sources of error. The use of well-designed, memorable laboratory and field experiences will facilitate this application of scientific knowledge and methodology and is essential in helping students to analyze the content critically. Students will learn how ethical considerations play an important role in modern earth science fields and explore the importance of personal accountability in both individual and group work situations.

LITERACY
- Students will improve their ability to learn independently by drawing generalizations from science related articles, books, graphs, charts, and diagrams. They will also learn the common scientific roots the make vocabulary in the earth and space sciences context more accessible. Regular opportunities are provided for students to clearly communicate their understanding through oral and written explanations of science concepts.

APPLICATIONS
- Students will study the applications of Earth sciences to environmental, commercial, and ethical issues to develop critical thinking skills, as they apply to decision making in both societal and personal contexts. They will explore both the education and self-promotion skills needed for these professions. This will inspire students to consider pursuing advanced studies in science and the wide variety of related career choices.

COURSE PURPOSE: EXPECTED OUTCOMES

Students are expected to perform at a proficient level on a variety of tasks and assessments addressing both the content and skill standards for Earth Sciences. Levels of proficiency are defined near the end of this course outline under Performance Standards.

Grade 9-12 Earth Sciences:

from the Science Standards for California Public Schools, adopted by the California State Board of Education in October, 1998.

Earth's Place in the Universe .... (20.0% of CST)

1. Solar System - Astronomy and planetary exploration reveal the solar system's structure, scale, and change over time.
2. Stars, Galaxies, and the Universe - Earth-based and space-based astronomy reveal the structure, scale, and changes in stars, galaxies, and the universe over time.

Dynamic Earth Processes .... (15.0% of CST)

3. Plate tectonics operating over geologic time has changed the patterns of land, sea, and mountains on Earth's surface.

Energy in the Earth System .... (30.0% of CST)

4. Solar Energy Enters, Heat Escapes - Energy enters the Earth system primarily as solar radiation and eventually escapes as heat.
5. Ocean and Atmospheric Convection - Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.
6. Climate and Weather - Climate is the long-term average of a region's weather and depends on many factors.

Biogeochemical Cycles .... (8.3% of CST)

7. Each element on Earth moves among reservoirs, which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles.

Structure and Composition of the Atmosphere .... (8.3% of CST)

8. Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life.

California Geology .... (8.3% of CST)

9. The geology of California underlies the state's wealth of natural resources as well as its natural hazards.

Investigation and Experimentation .... (10.0% of CST)

1. 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 four strands, students should develop their own questions and perform investigations. Students will:
   - a. select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data. (CST)
   - b. identify and communicate sources of unavoidable experimental error. (CST)
   - c. identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions. (CST)
   - d. formulate explanations by using logic and evidence. (CST)
   - f. distinguish between hypothesis and theory as scientific terms. (CST)
   - g. recognize the usefulness and limitations of models and theories as scientific representations of reality. (CST)
   - h. read and interpret topographic and geologic maps. (CST)
   - i. analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem). (CST)
   - j. recognize the issues of statistical variability and the need for controlled tests. (CST)
   - k. recognize the cumulative nature of scientific evidence. (CST)
   - l. analyze situations and solve problems that require combining and applying concepts from more than one area of science. (CST)
   - m. investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California. (CST)
   - n. know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e. g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets). (CST)

CST = Standards assessed on the California Standards Test

COURSE PURPOSE: EXPECTED INTEGRATED OUTCOMES

Students are also expected to proficiently apply common skills that are relevant across curriculum areas and career pathways. The following are those skills most applicable to this science course.

CTE Foundation Standards:

from the California Career Technical Education Model Curriculum Standards, adopted by the California State Board of Education in May, 2005.

Foundation Standard 2: Communications

Students understand the principles of effective oral, written and multimedia communication in a variety of formats and contexts.

Reading (Grades 9-10)

1.3 Identify Greek, Roman, and Norse mythology and use the knowledge to understand the origin and meaning of new words.
2.2 Prepare a bibliography of reference materials for a report using a variety of consumer, workplace, and public documents.
2.3 Generate relevant questions about readings on issues that can be researched.
2.8 Evaluate the credibility of an author's argument or defense of a claim by critiquing the relationship between generalizations and evidence, the comprehensiveness of evidence, and the way in which the author's intent affects the structure and tone of the text (e.g., in professional journals, editorials, political speeches).

Writing (Grades 9-10)

1.3 Use clear research questions and suitable research methods (e.g., library, electronic media, personal interview) to elicit and present evidence from primary and secondary sources.
1.5 Synthesize information from multiple sources and identify complexities and discrepancies in the information and the different perspectives found in each medium (e.g., almanacs, microfiche, news sources, in-depth field studies, speeches, journals, technical documents).
2.3 Write expository compositions, including analytical essays and research reports:
  2.3.a Marshal evidence in support of a thesis and related claims, including information on all relevant perspectives.
  2.3.b Convey information and ideas from primary and secondary sources accurately and coherently.
  2.3.c Make distinctions between the relative value and significance of specific data, facts, and ideas.
  2.3.d Include visual aids by employing appropriate technology to organize and record information on charts, maps, and graphs.
  2.3.e Anticipate and address readers' potential misunderstanding, biases, and expectations.
  2.3.f Use technical terms and notations accurately.
2.6 Write technical documents:
  2.6.a Report information and convey ideas logically and correctly.
  2.6.b Offer detailed and accurate specifications.
  2.6.c Include scenarios, definitions, and examples to aid comprehension (e.g., troubleshooting guide).
  2.6.d Anticipate reader's problems, mistakes, and misunderstandings.

Written and Oral English Language Conventions (Grades 9-10)

1.4 Produce legible work that shows accurate spelling and correct use of the conventions of punctuation and capitalization.

Listening and Speaking (Grades 9-10)

1.7 Use props, visual aids, graphs, and electronic media to enhance the appeal and accuracy of presentations.
2.3 Apply appropriate interviewing techniques:
  2.3.a Prepare and ask relevant questions.
  2.3.b Make notes of responses.
  2.3.c Use language that conveys maturity, sensitivity, and respect.
  2.3.d Respond correctly and effectively to questions.
  2.3.e Demonstrate knowledge of the subject or organization.
  2.3.f Compile and report responses.
  2.3.g Evaluate the effectiveness of the interview.
2.5 Deliver persuasive arguments (including evaluation and analysis of problems and solutions and causes and effects).
  2.5.a Structure ideas and arguments in a coherent, logical fashion.
  2.5.b Use rhetorical devices to support assertions (e.g., by appeal to logic through reasoning; by appeal to emotion or ethical belief; by use of personal anecdote, case study, or analogy).
  2.5.c Clarify and defend positions with precise and relevant evidence, including facts, expert opinions, quotations, expressions of commonly accepted beliefs, and logical reasoning.
  2.5.d Anticipate and address the listener's concerns and counterarguments.

Foundation Standard 3: Career Planning and Management

Students understand how to make effective decisions, use career information, and manage career plans.

3.5 Understand the past, present, and future trends that affect careers, such as technological developments and societal trends, and the resulting need for lifelong learning.
3.6 Know important strategies for self-promotion in the hiring process, such as job applications, resume writing, interviewing skills, and preparation of a portfolio. [*re: earth/space science careers, i.e., resources, std 9a*]

Foundation Standard 4: Technology

Students know how to use contemporary and emerging technological resources in diverse and changing personal, community, and workplace environments.

4.2 Understand the use of technological resources to gain access to, manipulate, and produce information, products, and services.

4.3 Understand the influence of current and emerging technology on selected segments of the economy.

Foundation Standard 5: Problem Solving and Critical Thinking

Students understand how to create alternative solutions by using critical and creative thinking skills, such as logical reasoning, analytical thinking, and problem solving techniques.

5.1 Apply appropriate problems-solving strategies and critical thinking skills to work-related issues and tasks.
5.3 Use critical thinking skills to make informed decisions and solve problems.

[*re: global climate change, earth science std 4c*]

Foundation Standard 6: Health and Safety

Students understand health and safety policies, procedures, regulations, and practices, including the use of equipment and handling of hazardous materials.

6.1 Know the policies, procedures, and regulations regarding health and safety in the workplace, including employers' and employees' responsibilities.
6.2 Understand critical elements of health and safety practices related to storing, cleaning, and maintaining tools, equipment, and supplies.

Foundation Standard 7: Responsibility and Flexibility

Students know the behaviors associated with the demonstration of responsibility and flexibility in personal, workplace, and community settings.

7.1 Understand the qualities and behaviors that constitute a positive and professional work demeanor.
7.2 Understand the importance of accountability and responsibility in fulfilling personal, community, and workplace roles. [*re: energy, ES std 4a, water conservation, ES std 9c*]
7.3 Understand the need to adapt to varied roles and responsibilities.
7.4 Understand that individual actions can affect the larger community.

Foundation Standard 8: Ethics and Legal Responsibilities

Students understand professional, ethical, and legal behavior consistent with applicable laws, regulations, and organizational norms.

8.2 Understand the concept and application of ethical and legal behavior consistent with workplace standards.
8.3 Understand the role of personal integrity and ethical behavior in the workplace.

[*re: greenhouse gases, ES std 7c, resources, ES std 9a*]

Foundation Standard 9: Leadership and Teamwork

Students understand effective leadership styles, key concepts of group dynamics, team and individual decision making, the benefits of workplace diversity, and conflict resolution.

9.1 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace setting.
9.2 Understand the ways in which pre professional associations and competitive career development activities enhance academic skills, promote career choices, and contribute to employability.
9.3 Understand how to organize and structure work individually and in teams for effective performance and the attainment of goals.

[*re: Energy Debate, ES std 4a, or any group project, especially the project with Service Learning – see p. 43*]

9.5 Understand how to interact with others in ways that demonstrate respect for individual and cultural differences and for the attitudes and feelings of others.

OUTLINE OF CONTENT AND RECOMMENDED TIME ALLOTMENT:

The Task Analysis and Key Vocabulary presented here are drawn from the 2003 Science Framework for California Public Schools, which defines the intent and scope of the Science Content Standards. For additional information on the context and the benchmark standards to assess, refer to the Blueprints for the Earth Science Content Standards Test (CST). Skill Standards designated **FS** refers to the Foundation Standards of the CA Career Technical Education Model Curriculum Standards [pages 3 and 4]. Content sequencing, Labs/Demos, and time allocations are only suggestions and may be adjusted to suit school site curriculum plans, available materials, and student needs.

Earth's Place in the Universe (Solar System) **12% CST**

1. Astronomy and planetary exploration reveal the solar system's structure, scale, and change over time.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how the differences and similarities among the sun, the terrestrial planets, and the gas planets may have been established during the formation of the solar system. **(1,a)**	• Explain that the Nebula Theory is our best current model of how the solar system was formed. ◦ Recognize a nebula as the aftermath of a star exploding, a supernova. ◦ Explain that gravity pulls to the center of mass, not just "down". ◦ Explain how a gas nebula contracts by gravity pulling all the pieces to the middle. ◦ Explain that the gases begin to spin as they condense (like water going down a sink drain), heat up, and flatten out. This hypothesis is supported by observations that planetary orbits are in the same direction on the same plane. • Model how the planets form as clumps of matter collide and gather together. • Explain how the center gathers enough matter and heats up until nuclear fusion starts, forming the sun. • Construct ellipses to model orbits of planets and other objects orbiting around the sun. • Identify the components of the solar system and their orbits: ◦ Planets / Satellites ◦ Moons ◦ Asteroids ◦ Comets • Construct a scaled model of the solar system labeling orbital distances in km, AU, and light-minutes or hours. ***Skills Focus:*** Model, Analyze Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** • **Solar System Formation and Structure (1a & 1b)** [See description on p. 44.] ***Suggested:*** • **Nebula Clay Activity** Small pieces of circular clay are placed on desk and the students rub their hand over them simulating formations of heavenly bodies. (As more clay sticks together, larger pieces collect more clay simulating larger pull of gravity.) • PH ES, Activity, **Planetary Orbits**, p.643 • PH ES Lab Manual, **Exploring Orbits**, Inv. 23, p. 145 • Holt ES, Quick Lab, **Water Planetesimals**, p. 687 • Holt ES, Quick Lab, **Ellipses**, p. 692 OES: pending PT: pending	**PH ES**, Ch 23:1-3 **Holt ES**, Ch 27:1-4 ***Supplemental Resources:*** • PH ES, GEODE / Astronomy, **The Planets: An Overview** Discovery Channel video, Ch. 23, **Heavenly Bodies** • PH ES, GEODE / Astronomy, **A Brief Tour of the Planets** • PH ES, Teacher Demo, **Speeding Up a Spinning Nebula**, p. 647 (TE) • PH ES, **The Shape of a Planetary Orbit**, p. 643 • **Forming the Solar System Video:** http://sci2.esa.int/interactive/media/html/sec31p2.htm ***Key Vocabulary:*** gravity, force, massive, inertia, density, nebula, light hour, condensation, astronomical unit, vacuum, revolve, orbit, elliptical, radius, planet, solar, fusion, asteroid, comet, terrestrial, gas, solar wind, light speed, satellite, moon	4 Days

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the evidence from Earth and moon rocks indicates that the solar system was formed from a nebular cloud of dust and gas approximately 4.6 billion years ago. **(1,b)**	• Describe how scientists date objects using indirect relative (superposition) and absolute dating (using radioactive decay as a "clock" to the past). • Explain why relative dating methods are insufficient to identify actual dates for events in the deep past. • Recall that radioactive dating of rock samples from Earth, the Moon, and meteoroids indicate that the solar system formed from a nebula (a cloud of gas and debris) about 4.6 billion years ago. • Explain that the nebula that formed into the solar system was composed primarily of hydrogen and helium formed during the big bang. • Explain why the presence of heavier elements indicates that the supernova of an ancient star must have formed the nebula from which our solar system developed. • Create a method to model how the solar wind at the ignition of the Sun blew most the lighter gases to the outer parts of the solar system, so that outer planets are condensations of lighter elements. ***Skills Focus:*** Deduct, Differentiate Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem). **(I&E 1.i)** Recognize the cumulative nature of scientific evidence. **(I&E 1.k)**	***Key Assignments:*** • **Solar System Formation and Structure (1a & 1b)** [See description on p. 44.] ***Suggested:*** • PH ES, GEODE / Astronomy, **Calculating You Weight and Age on Other Planets** • PH ES, **Modeling The Solar System,** p. 666-667 • PH ES, **Modeling a Comet's Tail,** p. 662 (TE) OES: pending PT: pending	**PH ES**, Ch 1:1 and 23:1-3 **Holt ES**, Ch 27:1 ***Supplemental Resources:*** • Holt ES, Teach, Using the Figure**,** p. 686 (TE) • Holt ES, SciLinks, **Origins of the Solar System**, www.scilinks.org SciLInks code: HQ61087 ***Key Vocabulary:*** radioactive decay, absolute dating, half-life, radiation, isotopes, relative dating, sedimentary layers, superposition, fossil, meteorites, billion, planet, collapse, impact theory, supernova, accrete	4 Days

<table>
<tr><th colspan="2">Content Standards</th><th>Perf. Std. Measures
How students DEMONSTRATE KNOWLEDGE and SKILL.</th><th rowspan="2">Instructional Support</th><th rowspan="2">Appx Time</th></tr>
<tr><th>(CONTENT)
"Students know…"</th><th>(SKILL)
"Students are able to …"</th><th></th></tr>
<tr>
<td>…the evidence from geological studies of Earth and other planets suggest that the early Earth was very different from Earth today. (1,c)</td>
<td>

Describe how the planet Earth accumulated more mass as debris and planetoids collided and joined.
Explain how density caused heavier elements like iron to sink towards the center of the earth and lighter elements to rise to the surface.
Recall how the Earth has been slowly cooling since its formation and formed into layers:

Atmosphere – low density gases
Hydrosphere – water
Crust
Mantle
Core

Cite evidence that reveals that early earth was different from today in distribution of water, composition of the atmosphere, and the shapes, sizes, and positions of landmasses.
Restate that the oldest fossils are of anaerobic organisms, which were established 3.5 billion years ago.
Explain how continents have differentiated through the partial melting of rocks, with the lightest portions floating to the top.
Explain how the inclusion of iron oxide (rust) in "banded iron formations" indicates that the atmosphere gained enough oxygen for multicellular, aerobic organisms to flourish between one and three billion years ago.

Skills Focus:
Infer, Interpret, Compare

Distinguish between hypothesis and theory as scientific terms. (I&E 1.f)
</td>
<td>
Key Assignments:
- none -

Suggested:

Density Inquiry Activity
Have students place wax on water and then drill hole into it, make observations, try to make it sink.
Buoyancy Predictions
Students make predictions on the buoyancy of different objects of the same size based on the mass of the objects. Predict and then measure the mass of the same volume of water. Use this to justify buoyancy observations.
<u>PH ES</u>, Inquiry Activity, What Can Become a Fossil? p. 335
Have students research Index Fossils in cross sections of sedimentary rock layers and determine the relative age of the fossil and the environmental conditions necessary to sustain the organism.
<u>Holt ES</u>, Focus on the Standards, Activity, p. 688 TE

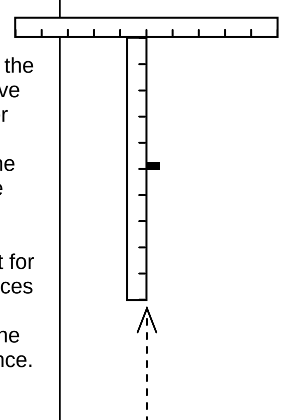
OES: pending
PT: pending
</td>
<td>
<u>PH ES</u>, Ch 12:1,2,4 and 13:1

<u>Holt ES</u>, Ch 27:1

Supplemental Resources:

Density Demos
Container of three different types of liquids (shake)
Container of 3 different types of solids (shake)
<u>PH ES</u>, GEODE / Geologic Time, Relative Dating
<u>PH ES</u>, GEODE / Geologic Time, Geologic Time Scale

Key Vocabulary:
atmosphere, magnetosphere
hydrosphere, dissolve
crust, geologic
mantle, continents
core, multicellular
lithosphere, anaerobic
composition, convection
ozone, uncomformity
fossil, relative dating
uniformatarianism
correlation
</td>
<td>5 Days</td>
</tr>
</table>

Content Standards		Perf. Std. Measures	Instructional Support	Appx Time
(CONTENT) "Students know…"	(SKILL) "Students are able to …"	How students DEMONSTRATE KNOWLEDGE and SKILL.		
…the evidence indicating that the planets are much closer to Earth than the stars are. **(1,d)**	• Describe how to determine that the planets in the solar system are closer than the stars. • Draw and label the visible electromagnetic spectrum. • Describe the Doppler Effect. ° Recall instances where sounds of cars, sirens, radios, etc. changed in pitch as they moved past. ° Diagram and explain how the motion of a source of waves affects wavelengths. ° Diagram a specific example of how the Doppler Effect explains the change in pitch heard in one of the instances cited above. ° Show the application of the same principles in light waves to explain why blue and red shifts indicate if an object in space is moving toward us or away from us. • Demonstrate how to use parallax to measure the distances to nearby stars. • Explain how the inverse square law describes how light intensity decreases exponentially with distance and how this is used to indirectly estimate the distances to very distant (extragalactic) objects. ***Skills Focus:*** Differentiate, Measure Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions. **(I&E 1.e)**	***Key Assignments:*** - none - ***Suggested:*** • **Doppler Demos** Take students to a busy road and have them listen to the sounds that cars make as they pass. Take a vacuum hose and twirl it above your head and listen to the sound (pitch) changes. Draw a before, during, and after diagram of a car with a siren passing a person. Draw the sound waves path to the persons ear and associate those changes to the blue or red shift. Students are given 2 Slinkies and asked to hold one end (student in the middle holds two ends). Student in the middle makes a wave pulse. Then repeat this while jumping toward one of the other students to model how motion of the source alters the waves. • **Measuring Paralax** Place two meter sticks in a T shape as shown to the right. Have students place a domino (or other small object) at 50 cm. With their right eye, the left edge should line up with the middle (50 cm mark) on the second meter stick. Have them then close or cover their right eye and read where the left edge of the domino lines up with the back meter stick. Have students record these observations and repeat for at least two other distances to show how parallax (reading the "jump" on the back ruler) shows distance.  • <u>PH ES</u>, Inquiry Activity, **How Do Astronomers Measure Distances to Nearby Stars?**, p. 699 • <u>Holt ES</u>, Quick Lab, **Parallax**, p. 779 OES: pending PT: pending	**<u>PH ES</u>**, Ch 22:1 and 25:1 **<u>Holt ES</u>**, Ch 27:2 and 30:1 ***Supplemental Resources:*** • <u>PH ES</u>, Teacher Demo, **A Simple Mirror Telescope**, p. 620 • <u>PH ES</u>, Quick Demo, **Absolute & Apparent Magnitudes**, p. 703 • <u>PH ES</u>, Teacher Demo, **Binary Star Motion**, p. 703 ***Key Vocabulary:*** wavelength, expansion, frequency, diameter, spectrum, angle, Doppler Effect, parallax, Doppler radar, trigonometry, red shift, extragalactic, blue shift, Inverse Square Law, constellation, nebulae, light year, ellipse, astronomical unit (AU), apparent magnitude, absolute magnitude	5 Days

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the Sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium. **(1,e)**	• Define fusion (nucleosynthesis) in their own words. • Explain how very high temperatures (particles moving fast) and pressures (particles packed close together) are needed to combine nuclei. • Show how scientists compare and contrast spectra from different stars to determine what elements are present. • Explain that the Sun is composed mainly of hydrogen, and helium fused from hydrogen nuclei. • Explain that only nuclear reactions can account for the enormous energy output (luminosity) of the Sun. • Explain how four hydrogen atoms come together to form 1 helium atom, releasing huge amounts of energy. The Sequence of fusion reactions in the sun occur as follows: **1st:** ${}_{1}^{1}H + {}_{1}^{1}H \rightarrow {}_{1}^{2}H + {}_{+1}^{0}e + v$ *("v"* represents a neutrino) **2nd:** ${}_{1}^{1}H + {}_{1}^{2}H \rightarrow {}_{2}^{3}He + \gamma$ *("γ" represents a gamma ray)* **3rd:** ${}_{2}^{3}He + {}_{2}^{3}He \rightarrow {}_{2}^{4}He + {}_{1}^{1}H + {}_{1}^{1}H$ A large amount of energy is produced each time a new, larger nucleus is formed as tiny portion of matter is converted to energy according to Einstein's equation, $E=mc^2$ (Energy = mass x speed of light squared). • Diagram how fusion in stars creates heavier elements, up to iron. ***Skills Focus:*** Diagram, Balance Equations Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • PH ES, **Tracking Sunspots**, pp.692-693 • PH ES Lab Manual, Inv. 24,**Measuring the Diameter of the Sun**, p. 151 • **Fusion Cartoon** Students create comic strip to illustrate the conversion of hydrogen to helium, showing conditions necessary for the collisions. • **Model Fusion** Students use clay to model fusion. • Holt ES, Quick Lab, **Modeling Fusion**, p. 757 OES: pending PT: pending	**PH ES**, Ch 24:3 **Holt ES**, Ch 29:1 ***Supplemental Resources:*** • **The Elements: Forged in Stars** http://www.teachersdomain.org/ [free to sign up for access] • Discovery Channel video, **Fireball**, Ch. 24 ***Key Vocabulary:*** atom, abundant, elements, energy, pressure, luminosity, nuclear reaction, sunspot, fusion, nucleosynthesis	5 Days

<table>
<tr><th colspan="2">Content Standards</th><th rowspan="2">Perf. Std. Measures
How students DEMONSTRATE KNOWLEDGE and SKILL.</th><th rowspan="2">Instructional Support</th><th rowspan="2">Appx Time</th></tr>
<tr><th>(CONTENT)
"Students know…"</th><th>(SKILL)
"Students are able to …"</th></tr>
<tr>
<td>… the evidence for the dramatic effects that asteroid impacts have had in shaping the surface of planets and their moons and in mass extinctions of life on Earth. (1,f)</td>
<td>• Define what an asteroid is.
• Describe how craters are created on heavenly bodies by impact asteroids.
• Explain why the Moon and Mercury have many more visible craters than the earth.
• Describe how active recycling has a role in reshaping the earth's surface.
• Describe how the iridium-rich layer of rock found between the Cretaceous and Tertiary periods could possibly explain the extinction of the dinosaurs.
• Predict what would occur from a large asteroid impact with the earth.

Skills Focus:
Analyze, Predict, Model

Distinguish between hypothesis and theory as scientific terms. (I&E 1.f)</td>
<td>Key Assignments:
• Asteroid Impacts: Past (and Future?) (possible) Students research ancient impacts as well as present information on near Earth objects and proposed methods to safeguard Earth. [further guidelines on p. 43]

Suggested:
• Creating Craters Drop marbles of different masses and sizes at different velocities into damp sand (soft clay or flour may also work) to observe the impact results. Have students experiment with ways to weather their craters, simulating Earth surface conditions. Use observations to inform predictions about major asteroid or comet impacts with the Earth, past and future.
• <u>PH ES</u>, Inquiry Activity, How Do Impact Craters Form?, p. 613
• <u>Holt ES</u>, Using the Figure, Comparing Craters, p. 740 TE

OES: pending
PT: pending</td>
<td><u>PH ES</u>, Ch 13:3 and 22:3
<u>Holt ES</u>, Ch 28:4 & 9:3

Supplemental Resources:
• <u>PH ES</u>, GEODE / Astronomy, Earth's Moon
• Near Earth Object Program http://neo.jpl.nasa.gov/
• Jupiter: Earth's Shield http://www.teachersdomain.org/ [free to sign up for access]

Key Vocabulary:
extinction, iridium
crater, energy
impact, heavenly body
asteroid, active recycling
debris, cretaceous
collision, tertiary
velocity, superposition</td>
<td>3 Days</td>
</tr>
<tr>
<td>… the evidence for the existence of planets orbiting other stars. (1,g*)</td>
<td>• Demonstrate different ways to change the intensity of light seen from a steady light source.
• Create (or generate using computer sensors) logical graphs showing the variation of light intensity created by the methods used above.
• Observe photo and graphical evidence acquired by scientists to prove the existence of planets orbiting hundreds of other stars.
• Explain why most stars with planets orbiting them would not be visible to us using the technique modeled above.

Skills Focus:
Brainstorm, Model, Graph

Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data. (I&E 1.a)</td>
<td>Key Assignments:
• "Exo-Planets" Project (possible) Students research methods and findings from projects locating planets around other stars. Students create a way to demonstrate an analogy to the methods used by scientists to share with other students. [further guidelines on p. 43]

Suggested:
OES: pending
PT: pending</td>
<td><u>PH ES</u>, Ch 24:2
<u>Holt ES</u>, [not directly addressed]

Supplemental Resources:
• The Search for Another Earth http://www.teachersdomain.org/ [free to sign up for access]
• JPL – Planet Quest http://planetquest.jpl.nasa.gov/
• Harvard-Smithsonian Center for Astrophysics: http://www.cfa.harvard.edu/ssp/
http://www.cfa.harvard.edu/ssp/stars_planets/exoplanets.html
• Planetary Science Institute http://www.psi.edu/~esquerdo/
• UC – Calif. Planet Survey http://exoplanets.org/cps.html
• Extrasolar Planets Encyclopaedia: http://exoplanet.eu/

Key Vocabulary:
oscillation, intensity
Reflecting telescope
Refracting telescope
Radio telescope</td>
<td>3 Days</td>
</tr>
</table>

Earth's Place in the Universe (Stars, Galaxies, and the Universe) ***8% CST***

2. Earth-based and space-based astronomy reveal the structure, scale, and changes in stars, galaxies, and the universe over time.

<table>
<tr><th colspan="2">Content Standards</th><th>Perf. Std. Measures</th><th rowspan="2">Instructional Support</th><th rowspan="2">Appx Time</th></tr>
<tr><th>(CONTENT)
"Students know…"</th><th>(SKILL)
"Students are able to …"</th><th>How students DEMONSTRATE KNOWLEDGE and SKILL.</th></tr>
<tr><td>… the solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years. (2,a)</td>
<td>• Explain that the solar system is one star system in a much larger system of a billion stars called the Milky Way galaxy.
• Draw the basic shape of the Milky Way from "side view" and "top view" perspectives, showing that it is a spiral galaxy.
◦ Label the edge-to-edge distance of the Milky Way as 100,000 light years.
◦ Locate the approximate position of the solar system within the Milky Way.
◦ Explain how our position within the Milky Way determines how stars appear to us at night.
◦ Convert distances from light years to astronomic units and/or kilometers to show the utility of measuring in large units (optional).
Skills Focus:
Visualize 3-D Perspective
Recognize the cumulative nature of scientific evidence. (I&E 1.k)</td>
<td>Key Assignments:
- none -
Suggested:
• Universe Trip
Students describe an imaginary journey from the "edge" of the universe to the Earth, describing what they see along the way.
• <u>Holt ES</u>, Maps in Action, The Milky Way, Charting the Galaxy, p. 804
OES: pending
PT: pending</td>
<td><u>PH ES</u>, Ch 25:3
<u>Holt ES</u>, Ch 30:3 and 26:1
Supplemental Resources:
• Galaxy Worksheets
www.scilinks.org
• <u>PH ES</u>, Activity, Model the Milky Way Galaxy, p. 716 (TE)
• <u>PH ES</u>, Doppler Effect: Stretching Light Waves, p. 718
• <u>Holt ES</u>, SciLinks, Milky Way Galaxy, www.scilinks.org
SciLInks code: HQ60964
Key Vocabulary:
solar system, constellation, magnitude, photosphere, chromosphere, corona, sunspot, galaxy, galaxy cluster, big bang</td>
<td>2 Days</td></tr>
<tr><td>… galaxies are made of billions of stars and comprise most of the visible mass of the universe. (2,b)</td>
<td>• Explain that the visible universe consists of stars found by the billions in galaxies.
• Explain that there are billions of galaxies in the universe separated from each other by great distances and are found in groups of varying numbers called clusters.
• Explain that scientists catalog galaxies and stars according to their coordinate location in the sky, their brightness, temperature, color, and other physical characteristics.
• Explain that most of the visible matter in the universe is found in stars.
• Explain that most matter in the universe is invisible (sometimes called "dark matter"), which is inferred from the effect of its gravity on visible matter.
Skills Focus:
Classify, Compare
Recognize the usefulness and limitations of models and theories as scientific representations of reality. (I&E 1.g)</td>
<td>Key Assignments:
- none -
Suggested:
• Deep Space Activity
http://amazing-space.stsci.edu/resources/explorations/hdf/
Students summarize their findings.
OES: pending
PT: pending</td>
<td><u>PH ES</u>, Ch 25:3
<u>Holt ES</u>, Ch 30:3 and 26:1
Supplemental Resources:
• <u>PH ES</u>, Types of Galaxies, Using Models Activity, p. 717 TE
• Astronomy Picture of the Day Archive [search "galaxies"]
http://antwrp.gsfc.nasa.gov/apod/archivepix.html
[search "galaxies" and "galaxies collide"]
• How and Why Galaxies Collide!
http://curious.astro.cornell.edu/question.php?number=351
• Images of Dark Matter
http://chandra.harvard.edu/photo/2006/1e0657/
• NASA - Dark Matter
http://map.gsfc.nasa.gov/universe/uni_matter.html
• <u>Holt ES</u>, SciLinks, Galaxies, www.scilinks.org
SciLInks code: HQ60632
Key Vocabulary:
galaxy, big bang, cluster, light year, Doppler shift, dark matter</td>
<td>2 Days</td></tr>
</table>

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
…the evidence indicating that all elements with an atomic number greater than that of lithium have been formed by nuclear fusion in stars. **(2,c)**	• Define nucleosynthesis as the fusion of two or more atomic nuclei to form a larger nucleus. ◦ Recall that atomic nuclei are positive and naturally repel each other. ◦ Explain why very high speeds are needed overcome the natural repulsion of nuclei so that they can collide and fuse. ◦ Define high temperature as fast motion at the atomic level. ◦ Explain fusion requires very high temperatures found only in the cores of stars, research particle accelerators, or hydrogen bombs. • Recall that hydrogen, helium, and lithium (atomic numbers 1, 2, and 3) are believed to be the only elements formed during the big bang. • Explain that the heavy elements were created by the fusion of light elements. • Explain that all elements heavier than lithium must have been formed by fusion reactions in the cores of stars. • Explain that elements heavier than iron needed the extreme conditions of a supernova to form. ***Skills Focus:*** Justify Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)**	***Key Assignments:*** • **Personal Nucleosynthesis Story** (possible) Students create a news article or write a story about how calcium in our bones or iron in our blood (or any other element in the body) was created in stars and eventually entered our bodies. Key details of conditions in the star are particularly important. *[further guidelines on p. 43]* ***Suggested:*** • PH ES Lab Manual, Inv. 25, **Modeling the Rotation of Neutron Stars**, p. 157 OES: pending PT: pending	**PH ES**, Ch 25:2 **Holt ES**, Ch 29:1 and 30:2 ***Supplemental Resources:*** • **Overcoming Repulsion** Students model the difficulty of having positive nuclei collide by trying to push together alike poles of two strong magnets. Have them then relate their observations to why fusion does not occur at low temperatures (low particle velocities). • **Light Elements and the Big Bang** http://map.gsfc.nasa.gov/m_uni/uni_101bbtest2.html • PH ES, Teacher Demo, **Modeling a Pulsar**, p. 713 • Holt ES, Internet Activity, **High-Energy Physics**, p. 101 TE ***Key Vocabulary:*** temperature, pressure, core, nucleus, particle accelerator, protostar, supernova	4 Days

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
…that stars differ in their life cycles and that visual, radio, and X-ray telescopes may be used to collect data that reveal those differences. **(2,d)**	• Explain that stars differ in size, color, chemical composition, surface gravity, and temperature. • Recall the visible and invisible types of electromagnetic radiation. • Show what scientists can learn about the characteristics of stars by studying radiation such as x-rays and radio waves. • Connect hands-on experience with a simple spectroscope to the way scientists separate and study visible and invisible light (electromagnetic radiation) to study the composition and behavior of stars. • Explain that stars go through a "life cycle" during which they are "born" (begin fusion) and eventually "die" (fusion ends as small, fusible nuclei are used up). • Show how the Hertzsprung-Russell (H-R) Diagram classifies stars according to temperature and luminosity, from which they can infer star processes and age. ***Skills Focus:*** Classify, Read Graphs Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** • **Spectroscope Lab** [See description on p. 44.] ***Suggested:*** • **"Star Search"** Given temperatures and corresponding magnitude numbers (use the sun = 1, for reference), have students identify the type of star and predict what the future holds for that star. (Refer to H-R diagram on PH ES p. 704 or Holt ES p. 781.) • **"Life" of a Star** Students draw labeled arrows on the H-R Diagram showing the Sun's movement from protostar to white dwarf. • **Stellar Mugshots** Students identify and sequence the life cycle(s) of stars using CHANDRA X-ray Observatory images from http://chandra.harvard.edu/ OES: pending PT: pending	**PH ES**, Ch 24:2 **Holt ES**, Ch 30:1,2 ***Supplemental Resources:*** • PH ES, **Making a Simple Refracting Telescope**, Teacher Demo, p. 679 • Discovery Channel video, Ch. 24, **Fireball** • **How to Build a Spectroscope** http://www.exploratorium.edu/spectroscope/ • **Relative Sizes** http://www.co-intelligence.org/newsletter/comparisons.html • **Life Cycle of a Star** http://map.gsfc.nasa.gov/universe/rel_stars.html • **Life Cycle of Stars with a Chart** http://en.wikipedia.org/wiki/Star • **Activities on Life Cycles of Stars** http://btc.montana.edu/ceres/html/LifeCycle/stars1.html#activity2 • **Evolution and Death of Stars** http://www.nasa.gov/audience/forstudents/9-12/features/stellar_evol_feat_912.html • Holt ES, SciLinks, **How Stars Evolve**, www.scilinks.org • Sci LInks code: HQ60764 ***Key Vocabulary:*** nebula, main sequence, white dwarf, radio telescope, neutron star, x-ray telescope, giant, reflecting telescope, supergiant, refracting telescope, black hole, constellation, electromagnetic spectrum	4 Days

<table>
<tr><th colspan="2">Content Standards</th><th>Perf. Std. Measures</th><th rowspan="2">Instructional Support</th><th rowspan="2">Appx Time</th></tr>
<tr><th>(CONTENT)
"Students know…"</th><th>(SKILL)
"Students are able to …"</th><th>How students DEMONSTRATE KNOWLEDGE and SKILL.</th></tr>
<tr>
<td>… accelerators boost subatomic particles to energy levels that simulate conditions in the stars and in the early history of the universe before stars formed. (2,e*)</td>
<td>• Describe how magnetic fields can be used to accelerate charged particles.
• Explain how electrostatic repulsion prevents nuclei from hitting each other at low speeds (low temperatures).
• Explain that particle accelerators use magnetic fields to create particle velocities great enough for nuclei to overcome electrostatic repulsion and collide so that nuclear reactions can take place, mimicking the nuclear fusion processes in stars and revealing that there are even smaller particles that make up what had been considered the most elementary particles: protons, neutrons, and electrons.
• Recall that 40 kg (88 pounds) worth of material must undergo fusion to convert 1 g (about one fifth of a 5¢ nickel) of matter to energy.
• Compute the amount of energy that can be generated from the conversion of 1g of matter using Einstein's equation, ($E=mc^2$).
• Explain that, so far, only stars can sustain fusion reactions.

Skills Focus:
Research, Apply

Formulate explanations by using logic and evidence. (I&E 1.d)</td>
<td>Key Assignments:
- none -

Suggested:

OES: pending
PT: pending</td>
<td><u>PH ES</u>, Ch 25:3

<u>Holt ES</u>, Ch 30:2 [does not directly address particle accelerators]

Supplemental Resources:
• PH ES, Teacher Demo, Stretching Light Waves, p. 719
• National Synchrotron Light Source: For Non-scientists http://www.nsls.bnl.gov/about/everyday/synchrotron.asp
• Stanford Linear Accelerator Center – Virtual Visitor Center http://www2.slac.stanford.edu/vvc/ accelerator.html
• Fermi National Accelerator Lab http://www.fnal.gov/
• European Synchrotron Radiation Facility http://www.esrf.eu/

Key Vocabulary:
nucleus — nuclear energy
nuclear fission — nuclear fusion
chain reaction — accelerator
repulsion — magnetic field
galaxy
galaxy Cluster
Big Bang</td>
<td>3 Days</td>
</tr>
</table>

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the evidence indicating that the color, brightness, and evolution of a star are determined by a balance between gravitational collapse and nuclear fusion. ***(2,f*)***	• *Explain that temperature is the measure of the underlying energy of a system (how fast the particles are moving, on average).* • *Explain that thermal energy can be radiated away into space as electromagnetic radiation including visible light.* • *Explain that as surface temperature of a star increases, the spectrum of radiation shifts towards higher energy, shorter wavelengths (blue or violet).* • *Conclude that a blue-white star is hotter than a red star.* • *Explain that stars are so hot that nuclei and electrons bounce around independently – a state of matter known as plasma.* • *Explain that gravity acts to collapse the hot plasma of the Sun.* • *Explain that the energy released by nuclear fusion in the core of a star creates an outward, expansion force that counteracts the gravitational force and prevents the collapse of the stellar core.* • *Describe how the heat energy produced in the core of a star flows from the hot core to the cooler surface where it is radiated away into space as starlight, attaining an energy balance.* • *Define energy balance for a star as the point where the energy being produced in the core equals the upward heat flow, which in turn equals the amount of energy being radiated out into space.* ***Skills Focus:*** Infer, Conclude Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • **Energy Balance Diagram** Diagram a cutaway view of the Sun showing its structure, and labeling the direction of heat energy transfer. Also, indicate how the expansion force created by the heat of the core is balanced by the gravity force holding the star together. • **Energy Balance in Stars** Students model the energy/gravity balance within stars in pairs. Students lean toward each other with their hands. One student represents the star's heat energy pushing out. The other student represents the star's gravity pushing toward the center of mass. Ask students what will happen if various conditions change. Students relate these changing conditions to phases of a star's existence. • Holt ES, Using the Figure, **Masses of Stars**, p. 783 TE OES: pending PT: pending	**PH ES**, Ch 25:2 **Holt ES**, Ch 30:2 ***Supplemental Resources:*** • PH ES, Integrate Physics: **Concepts of Fission and Fusion**, p. 708 TE • PH ES, Integrate Chemistry: **The Formation of Heavy Elements**, p. 711 TE • Holt ES, Group Activity, **Main-Sequence Stars**, p. 783 TE ***Key Vocabulary:*** thermal energy, spectrum radiation, wave length plasma, collapse expansion	4 Days

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how the red-shift from distant galaxies and the cosmic background radiation provide evidence for the "big bang" model that suggests that the universe has been expanding for 10 to 20 billion years. ***(2,g*)***	• *Explain that the "big bang" theory is the most accepted explanation for the origin of the universe.* ◦ *Explain that according to the big bang theory, the universe began as a point about 10 to 20 billion years ago.* ◦ *This point underwent an enormous explosion, from which matter, energy, and space itself have been expanding ever since.* • *Explain, as a review, the Doppler effect as it applies to electromagnetic radiation.* • *Analyze the significance of the red shift as it applies to distant galaxies.* • *Explain that there is another electromagnetic radiation or "background noise" has lead to the acceptance of a big bang theory of an expanding universe that is 10-20 billion years old.* • *Explain that a slight variation in the background radiation was discovered that is consistent with the theory of how matter in the early universe began to condense leading to the formation of stars.* ***Skills Focus:*** Distinguish between hypothesis and theory as scientific terms. **(I&E 1.f)**	***Key Assignments:*** • **Exploration Technology / Cosmology** (possible) Students explore and present the technology and people who have explored the furthest reaches of the universe. *[further guidelines on p. 43]* ***Suggested:*** • **The Big Bang Activity** www.tufts.edu/as/wright_center/cosmic_evolution/docs/ splash.html OES: pending PT: pending	**PH ES**, Ch 25:3 **Holt ES**, Ch 30:4 ***Supplemental Resources:*** • **Balloon Universe** Draw dots on a half-filled balloon. Note how the dots all become farther apart as the balloon is blown up (expanded), in the same way that galaxies are moving farther away from each other according to red shift evidence. • PH ES, Exploration Activity, **Observing Stars**, p. 723 • **NASA Picture of the Day: Inflating the Universe** http://antwrp.gsfc.nasa.gov/apod/ap060323.html • **Cosmic Background Radiation** http://en.wikipedia.org/wiki/Cosmic_microwave_background_radiation http://map.gsfc.nasa.gov/universe/bb_tests_cmb.html http://lambda.gsfc.nasa.gov/product/cobe/slide_captions.cfm http://cmb.phys.cwru.edu/boomerang/ • **How the Universe Will End - TIME** http://www.time.com/time/covers/1101010625/story.html • Holt ES, Quick Lab, **The Expanding Universe**, p. 795 ***Key Vocabulary:*** universe background expand	3 Days

Dynamic Earth Processes **15% CST**

3. Plate tectonics operating over geologic time has changed the patterns of land, sea, and mountains on Earth's surface.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures — How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
…features of the ocean floor (magnetic patterns, age, and sea-floor topography) provide evidence of plate tectonics. **(3,a)**	• Identify seafloor topographic features (midocean ridges volcanoes, rift valleys, seamounts, etc.). • Relate the topographic features to one another and to the geologic forces that formed them. • Explain that the midocean ridge system is the longest topographic feature on Earth and that it provides some of the best evidence for continental drift. ° Recall that absolute dating shows that the ridge is made of the youngest rock on the ocean floor. ° Explain why as you move away from the ridge, on either side, the rock becomes older, the sediment covering the rock thickens, and the fossils found in the sediment are progressively older. ° Explain that the Earth's magnetic field is recorded in the ocean floor rock as they cool from lava. ° *Describe how scientists detect the magnetic bands by looking at the total magnetic field near the rocks. In areas where the Earth's magnetic field and the rock's magnetic field align, the total field is strong. Where the rock's field opposes the Earth's magnetic field, the total magnetic field measured is low.* ° Create a model to explain how alternating magnetic bands on both sides of the midocean ridge help support the plate tectonic theory. • Illustrate how the process of continental drift is driven by the convection of the mantle and asthenosphere. • Describe the convective cycle where the youngest rock is being formed at the midocean ridges and the oldest rock is returned to the mantle at deep ocean trenches and subduction zones. ***Skills Focus:*** Model, Justify Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** OES: pending PT: pending	**PH ES**, Ch 9:3 and 14:1,2 **Holt ES**, Ch 10:1,2 ***Supplemental Resources:*** • PH ES, Teacher Demo, **Creating a Continental Rift**, p. 260 • PH ES, Exploration Lab, **Paleomagnetism and the Ocean Floor**, p. 272-273 • Discovery Channel video, **Plate Tectonics**, • PH ES, GEODE: Oceans, **Floor of the Ocean** • Discovery Channel video, **Sea Floor Maps** • Holt ES, Misconception Alert, **Mineral Magnetism**, p. 24_4 TE • Holt ES, Using the Figure, **Magnetic Polarity**, p. 245 THE ***Key Vocabulary:*** continental drift, midocean ridge, plate tectonics, polarity, topography, composition, sea-floor spreading, convective cycle, convection, mantle, asthenosphere, subduction zone	4 Days

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
…the principal structures that form at the three different kinds of plate boundaries. **(3,b)**	• Define and model the three types of plate boundary interactions (convergent boundaries, divergent boundaries, and transform (also known as parallel slip or strike slip) boundaries). • Describe specific topographical features caused by the interactions at plate boundaries (trenches, rift valleys, mountain ranges, volcanoes). • Illustrate the different results that may occur at a convergent boundary when two different density plates collide and when two similar density plates collide, citing specific examples. • Locate the San Andreas Fault on a map and identify which parts of California and Mexico are on the Pacific Plate and which are on the North American Plate. • Identify evidence of plate interactions on maps or geographic globes. ***Skills Focus:*** Illustrate Read and interpret topographic and geologic maps. **(I&E 1h)**	***Key Assignments:*** • **Mapping Topography & Using Longitude and Latitude** [See description on p. 44.] ***Suggested:*** • PH ES, Teacher Demo, **Building a Convergent Model**, p.256 • PH ES,Map Skills Activity: **Locating Tectonic Plates**, p. 256 • Holt ES, Quick Lab, **Tectonic Plate Boundaries**, p. 253 • Holt ES, Making Models Lab, **Continental Collisions**, p. 290 OES: pending PT: pending	**PH ES**, Ch 9:2,3 and 11:2,3 **Holt ES**, Ch 10:2 and 19:2 ***Supplemental Resources:*** • Discovery Channel video, **Earthquake Zones** • PH ES, Exploration Lab, **Investigating Anticlines & Synclines**, p. 326 ***Key Vocabulary:*** boundary, plates, convergent, lithosphere, subduction, trench, divergent, rift valley, transform boundary, fault (a.k.a. parallel slip or strike slip boundary), stress, strain, plate tectonics	4 Days
… how to explain the properties of rocks based on the physical and chemical conditions in which they formed, including plate tectonic processes. **(3,c)**	• Explain that rocks are classified according to chemical composition and texture. • Describe how rock characteristics tell the history of processes the rock has been through. ◦ Explain why composition tells what chemicals were present when the rock formed. ◦ Explain how texture indicates the pressure and temperature conditions the rock has experienced. ◦ Identify textures common to igneous, sedimentary, and metamorphic rocks. • Describe the processes involved in the rock cycle citing where and how these processes occur. • Explain how plate tectonic subduction and uplift processes affect the distribution and characteristics of rocks. ***Skills Focus:*** Classify, Compare and Contrast Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena. **(I&E 1.i)**	***Key Assignments:*** • **Rock Lab** [See description on p. 44.] ***Suggested:*** • PH ES, Inquiry Activity, **Similarities & Differences Among Rocks**, p. 65 • PH ES, Exploration Lab, **Rock Identification**, p. 86-87 • Holt ES, Alt. Assessment, **Travel Brochure**, p. 134 TE • Holt ES, Quick Lab, **Graded Bedding**, p. 139 • Holt ES, Skills Practice Lab, **Classification of Rocks**, p 150 OES: pending PT: pending	**PH ES**, Ch 2:1, 3:1-4, and 11:1 **Holt ES**, Ch 6:1-4 ***Supplemental Resources:*** • PH ES, Teacher Demo, **Isotopes and Numbers**, p. 39 • PH ES, GEODE, **Earth Materials** • PH ES, Teacher Demo, **Crystal Formation**, p. 72 • PH ES, Teacher Demo, **Chemical Weathering**, p. 77 ***Key Vocabulary:*** rock, non-foliated, igneous rock, sediment, lava, sedimentary rock, basaltic, compaction, granitic, cementation, intrusive, superposition, extrusive, unconformity, foliated, relative age, metamorphic rock	5 Days

Content Standards		Perf. Std. Measures	Instructional Support	Appx Time
(CONTENT) "Students know…"	(SKILL) "Students are able to …"	How students DEMONSTRATE KNOWLEDGE and SKILL.		
… why and how earthquakes occur and the scales used to measure their intensity and magnitude. **(3,d)**	• Describe and model how earthquakes occur when plate tectonic pressures overcome frictional forces and release the energy stored as elastic strain. • Explain that the magnitude of earthquakes depends on the amount of energy released. • Explain the logarithmic nature of the Richter magnitude scale means that 7.0 earthquake has ten times greater amplitude (ground movement) than a 6.0 earthquake. An 8.0 earthquake would a hundred times more amplitude than a 6.0 earthquake. • Apply the modified Mercalli scale to (subjectively) determine earthquake magnitude based on the effects observed. • *Explain how earthquake energy travels in fast-moving Primary, P (compression), and slower-moving Secondary, S (transverse) seismic waves.* • *Apply the speed differences between P and S waves to triangulate an earthquake epicenter.* ***Skills Focus:*** Read Graphs, Measure, Model Select and use appropriate tools and technology to perform tests, collect data, analyze relationships, and display data. **(I&E 1.a)**	***Key Assignments:*** • **Epicenter Triangulation** [See description on p. 44.] ***Suggested:*** • **Seismic Mapping** Have students monitor daily seismic activity from the United States Geological Survey (USGS) website and design a way to display the information on a map and/or graphically. • PH ES, **Measuring Distance to Epicenters**, p. 226 • PH ES, **Locating an Earthquake**, p. 240-1 • **Socratic Seminar using** PH ES, People and the Environment, **The San Andreas Fault System**, p. 325 • Holt ES, Alt. Assessment, **Earthquake Patterns**, p. 300 TE • Holt ES, Alt. Assessment, **Sizing Up Quakes**, p. 304 TE OES: pending PT: pending	**PH ES**, Ch 8:1,2 and 9:4 **Holt ES**, Ch 12:1,2 ***Supplemental Resources:*** • PH ES, Teacher Demo, **Sweet Stress**, p. 219 • PH ES, Teacher Demo, **Seismic Waves**, p. 223 • Holt ES, Group Activity, **Modeling Locked Faults**, p. 296 TE ***Key Vocabulary:*** normal fault reverse fault strike-slip fault seismic waves focus primary wave secondary wave surface wave epicenter seismograph magnitude liquefaction tsunami	5 Days

Content Standards		Perf. Std. Measures	Instructional Support	Appx Time
(CONTENT) "Students know…"	(SKILL) "Students are able to …"	How students DEMONSTRATE KNOWLEDGE and SKILL.		
… there are two kinds of volcanoes: one kind with violent eruptions producing steep slopes and the other kind with voluminous lava flows producing gentle slopes. **(3,e)**	• Describe and explain the characteristics of volcanoes with high viscosity lava. ◦ Identify low temperature, silica-rich lava as very viscous. ◦ Explain that viscous lava traps gases until pressures build up enough to produce explosive eruptions. ◦ Explain that explosive eruptions scatter tephra (ash and volcanic fragments) widely. ◦ Describe or model how viscous lava flows poorly and therefore piles up into steep-sided volcanoes. • Describe and explain the characteristics of volcanoes with low viscosity lava. ◦ Identify high temperature, iron-rich lava as being very fluid. ◦ Explain that fluid lava allows gases to easily escape, without building up pressure. ◦ Describe or model how fluid lava flows well and therefore builds gently sloping shield volcanoes. ***Skills Focus:*** Modeling, Contrasting Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** • **Life Near Plate Boundaries** [3b,d,e,f*] (possible) Students explore and present the personal impacts on the lives of people living on and near tectonic plate boundaries. *[further guidelines on p. 43]* ***Suggested:*** • PH ES, **Where Are Volcanoes Located**, p. 279 • PH ES, **Why Are Some Volcanoes Explosive**, p. 281 • Holt ES, Quick Lab, **Volcanic Cones**, p. 329 OES: pending PT: pending	**PH ES**, Ch 10:1 **Holt ES**, Ch 13:2 ***Supplemental Resources:*** • **Types of Volcanoes - USGS** http://pubs.usgs.gov/gip/volc/types.html • **Viscosity Demo** Have identical, sealed jars filled with colored, transparent liquids of different viscosities. (i.e., water, mineral oil, liquid soap and honey). Leave a little space for air. Invert the jars to show how the movement of gas is impeded by high viscosity. • **Modeling Volcano Types** To model a cinder cone, use dry sand or salt (dropped from a low height). To model a shield volcano, use wet sand or salt. To get the right consistency, fill a beaker half to two thirds full of sand or salt. Then add water until the water level is above the sand. • PH ES, Teacher Demo, **Observing an Explosive Eruption**, p. 285 • PH ES, GEODE, **Forces Within: Igneous Activity** • Holt ES, Focus on the Standards, **Teaching to Mastery**, p. 326 TE ***Key Vocabulary:*** viscosity (n.), viscous (adj.), fluid (adj.), lava, volcano, shield volcano, cinder cone volcano, composite volcano, hot spot, vent, crater, ash, tephra	3 Days

<table>
<tr><th colspan="2">Content Standards</th><th rowspan="2">Perf. Std. Measures
How students DEMONSTRATE KNOWLEDGE and SKILL.</th><th rowspan="2">Instructional Support</th><th rowspan="2">Appx Time</th></tr>
<tr><th>(CONTENT)
"Students know…"</th><th>(SKILL)
"Students are able to …"</th></tr>
<tr>
<td>… the explanation for the location and properties of volcanoes that are due to hot spots and the explanation for those that are due to subduction. (3,f*)</td>
<td>• Recall that rocks from the upper crust are high in silica content (granitic).
• Explain that subduction zones that cause upper crustal rocks to melt form volcanoes in which violent eruptions are common.
• Recall that rocks from the lower crust are high in iron content (basaltic).
• Explain that where lower crustal rocks melt, such as at midocean spreading zones, quiet, fluid eruptions are common.
• Explain how long-lived hot spots deep in the mantle heat magma that can rise up through the crust to create volcanoes.
• Explain that the type of crustal rock that gets melted into the rising magma determines whether it will erupt quietly (as in Hawaii) or explosively (as at the Yellowstone Caldera Complex).
• Describe how the Hawaiian Islands provide proof for the theory of plate tectonics.

<u>Skills Focus:</u>
Recognize Cause and Effect

Formulate explanations by using logic and evidence. (I&E 1.d)</td>
<td><u>Key Assignments:</u>
- none -

<u>Suggested:</u>
• Volcanic Personality Skits Have students find a way to dramatically contrast the behaviors of basaltic and granitic volcanoes.

OES: pending
PT: pending</td>
<td><u>PH ES</u>, Ch 9:4 and 10:3

<u>Holt ES</u>, Ch 13:1

<u>Supplemental Resources:</u>
• Hawaiian Volcanoes: http://hvo.wr.usgs.gov/volcanoes/

http://pubs.usgs.gov/fs/fs074-97/
• Measuring Volcanoes www.math.montana.edu/~nmp/materials/ess/geosphere/expert/activities/volcanoes/index.html
• Yellowstone – Investigating Hot Spots www.math.montana.edu/~nmp/materials/ess/geosphere/advanced/activities/hotspots/index.html
• Yellowstone Supervolcano: http://dsc.discovery.com/convergence/supervolcano/supervolcano.html
• Yellowstone: http://volcanoes.usgs.gov/yvo/about/
• Discovery Channel Video, Ch. 10, Death and Destruction

<u>Key Vocabulary:</u>
viscosity granitic
caldera basaltic</td>
<td>3 Days</td>
</tr>
</table>

Energy in the Earth System (Solar Energy Enters, Heat Escapes) *8% CST*

4. Energy enters the Earth system primarily as solar radiation and eventually escapes as heat.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the relative amount of incoming solar energy compared with Earth's internal energy and the energy used by society. **(4,a)**	• Describe evidences of Earth's enormous internal energy: plate tectonics, volcanism, and geothermal vents. • Explain that primitive, original heat from the Earth's formation and continuous decay of radioactive elements within the Earth are the only two known sources of Earth's internal energy. • Explain that the insulating properties of the Earth's crust allow only small amounts of the internal energy to reach the surface over short periods of time. • Explain that the vast majority of energy available to us at the Earth's surface comes as infrared, visible, and ultraviolet light (electromagnetic radiation) from the Sun. • Illustrate how the primary source of energy in modern societies originates as solar energy trapped by photosynthesis and stored in the Earth's crust as fossil fuels. • Explain that stored fossil fuel supplies are limited because they are consumed much faster that they are formed. • Recall that 1,000 joules (equivalent to 1 kilowatt) of solar energy reach every square meter of Earth's illuminated surface each second, which is the same rate at which the average U.S. household consumes energy. • Explain that since there is not an average U.S. household on every square meter of the Earth's surface, the total energy used by humans is small compared to the amount of energy received from the Sun. • Explain ways that current technology and costs limit the harvesting of this energy. ***Skills Focus:*** Read and interpret topographic and geologic maps. **(I&E 1.h)** Understand how to organize and structure work individually and in teams for effective performance and the attainment of goals. **(FS 9.3)** Understand the importance of accountability and responsibility in fulfilling personal, community, and workplace roles. **(FS 7.2)**	***Key Assignments:*** • **Energy Research/Debate** (possible) [4a 7b,d*] Students make a chart to compare the cost of using fossil fuels to the cost of converting solar energy. Include both monetary and non-monetary costs. Follow up with a debate over different sources of energy for society. Alternatively, students can make energy resource presentations as if to influence policy at the state or federal level. *[further guidelines on p. 43]* ***Suggested:*** • **Energy Pathways** Students diagram how solar energy drives a car or powers human actions, showing the path from the sun to plants, etc. • **Uses of Fossil Fuels** Refer to Glen ES, p 120, Table 1 Make a table like the one shown. Add a column showing how each fossil fuel is formed. OES: pending PT: pending	**PH ES**, Ch 4:2 **Holt ES**, Ch 2:2 ***Supplemental Resources:*** • **Earth Structure Model** Construct a crustal rock formation model showing stored fossil fuels. • **Quick Demo: Inexhaustible Energy** Glen ES, TE, p 131 • PH ES, Using Models, **Making a Solar Oven**, p. 103 TE • PH ES, Demo., **Modeling Hydroelectric Power**, p. 105 TE • PH ES, Demo., **Making a Geyser**, p. 106 TE • Holt ES, QuickLab, **Effects of Solar Energy**, p. 103 TE ***Key Vocabulary:*** electromagnetic radiation infrared, insulating ultraviolet, fossil fuels wavelength, energy kilowatt, joule	5 Days

<table>
<tr><th colspan="2">Content Standards</th><th rowspan="2">Perf. Std. Measures
How students DEMONSTRATE KNOWLEDGE and SKILL.</th><th rowspan="2">Instructional Support</th><th rowspan="2">Appx Time</th></tr>
<tr><th>(CONTENT)
"Students know…"</th><th>(SKILL)
"Students are able to …"</th></tr>
<tr>
<td>… the fate of incoming solar radiation in terms of reflection, absorption, and photosynthesis.
(4,b)</td>
<td>• Describe how the fate of incoming solar radiation depends on its wavelength.
° Explain that long wavelength light, like infrared, is absorbed by atmospheric gases, while visible light and shorter wavelengths are not absorbed.
° Recall that ultraviolet light is a short wavelength light that is absorbed by the ozone layer in the upper atmosphere.
° Explain that clouds, dust and the Earth's surface reflect some visible radiation back into space, but the rest is absorbed.
• Explain that the green appearance of plants indicates that orange, red and blue light are absorbed by plants for photosynthesis, and the green light simply reflects off.
• Recall that photosynthesis consumes carbon dioxide and water to produce sugar, storing the solar energy in chemical bonds that represent the primary source of energy for life on Earth.
• Explain why carbon dioxide declines slightly during the summer growing season, and decreases again in the winter.

Skills Focus:
Analyze situations and solve problems that require combining and applying concepts from more than one area of science. (I&E 1.l)</td>
<td>Key Assignments:
• Greenhouse Effect
(possible) [4b,c,d* 6d*]
Students study evidence, models, and projections of the Greenhouse Effect on Earth.
[further guidelines on p. 43]

Suggested:
• Elodea O_2 Production
Observe oxygen production by elodea under varying amounts of light. Relate observations of oxygen production to carbon dioxide consumption.
• Investigating Prism
Students investigate how to use prisms to split light into its component colors. What conclusions do they draw about infrared and ultraviolet wavelengths of light?
• Solar Energy in the Solar System
Students predict the fate of solar radiation on other planets taking into account the gases found in the other planets' atmospheres.

OES: pending
PT: pending</td>
<td>PH ES, Ch 17:2

Holt ES, Ch 22:2

Supplemental Resources:
• PH ES, Teacher Demo., Heat Conduction, p. 484 TE
• PH ES, Build Science Skills, Using Models, p. 484 TE
• Holt ES, Motivate Activity, Magic with Beads, p. 555 TE

Key Vocabulary:
radiation, photosynthesis
absorption, short wave
long wave, spectrum
ozone, carbon dioxide</td>
<td>4 Days</td>
</tr>
</table>

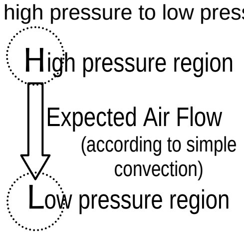
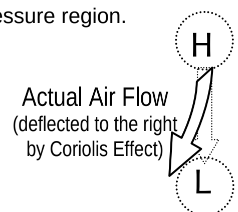
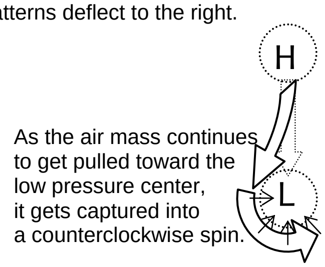
Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
…the different atmospheric gases that absorb the Earth's thermal radiation and the mechanism and significance of the greenhouse effect. **(4,c)**	• Recall that all objects give off electromagnetic radiation according to their temperature called "black body radiation". • Cite examples to prove that the hotter an object is, the shorter the wavelengths of electromagnetic radiation are emitted. *(For instance, a warm piece of iron emits infrared light, hot iron emits red visible light ("red hot"), and extremely hot iron can emit bluish-white light ("white hot").)* • Explain that since the Sun is hotter that the Earth, it emits radiation primarily in the visible range, which is shorter wavelength than the infrared radiation the Earth emits back into space. • Explain that greenhouse gases (including water vapor, carbon dioxide, methane, and some nitrogen oxide pollutants) in the atmosphere transmit visible light, but absorb infrared light. • Explain that Earth is kept warmer because greenhouse gases allow energy from the Sun in, but slow the loss of energy back into space. • Describe ways humans increase the amount of greenhouse gases. • Explain that the buildup of greenhouse gases could affect global temperatures and weather patterns, but predicting long-term effects is difficult because the influence of cloud cover and other factors are poorly understood. ***Skills Focus:*** Apply Analogy Use critical thinking skills to make informed decisions and solve problems. **(FS 5.3)** Identify and communicate sources of unavoidable experimental error. **(I&E 1.b)**	***Key Assignments:*** • **Global Climate Change Research** [4c, 6b-d*] (possible) Students research both historic patterns and current trends in global climate change. *[further guidelines on p. 43]* ***Suggested:*** OES: pending PT: pending	**<u>PH ES</u>**, Ch 4:3, 21:3, and 17:2 **<u>Holt ES</u>**, Ch 22:2 ***Supplemental Resources:*** • <u>PH ES</u>, Lab Manual, p. 137 Modeling the Greenhouse Effect • <u>PH ES</u>, Address Misconceptions, Greenhouse Effect vs. Global Warming, p. 487 TE • <u>Holt ES</u>, SciLinks, **Greenhouse Effect**, www.scilinks.org SciLInks code: HQ60694 • <u>Holt ES</u>, Focus on the Standards, Activity, p. 556 TE ***Key Vocabulary:*** constituent, thermal radiation, global warming, greenhouse, nitrogen oxide, methane, carbon dioxide, water vapor, "blackbody" radiation	4 Days

Content Standards (CONTENT) "Students know…"	 (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the differing greenhouse conditions on Earth, Mars, and Venus; the origins of those conditions; and the climatic consequences of each. ***(4,d*)***	• *Compare the atmospheric conditions on Mars and Venus to Earth.* ° *Explain that the surface of Venus is extremely hot (hotter than Mercury, which is closer to the Sun), because of its thick atmosphere, rich in greenhouse gases.* ° *Explain that because Mars has a very thin atmosphere, with virtually no greenhouse gases, and no oceans, it cannot store heat and experiences wide temperature swings between night and day.* ° *Explain that Earth's moderate greenhouse effect is important to our climate. Without it, Earth would be much colder and more like Mars.* • *Explain how the burning of fossil fuels for electricity and heat has contributed to an increase in greenhouse gases in Earth's atmosphere, especially carbon dioxide.* • *Explain that computer models predict an increase in the average global temperature, which could affect weather patterns and ocean levels.* • *Cite examples of feedback mechanisms that complicate the greenhouse theory and make predictions uncertain. (For instance, increased atmospheric carbon dioxide could increase the population of photosynthetic organisms remove more carbon dioxide from the atmosphere. Or, increased temperature would increase evaporation leading to more cloud cover, which would reflect more incoming solar radiation into space. This would in turn reduce the light available for photosynthesis.)* ***Skills Focus:*** Analyze, Contrast Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions. **(I&E 1.c)**	***Key Assignments:*** - none - ***Suggested:*** • **Analytic Activity:** Create a triple Venn diagram to compare and contrast atmospheric conditions on Mars, Earth and Venus. • **Planetary Greenhouses** Students compare and contrast the greenhouse effect on Venus, Earth, and Mars. Include diagrams to illustrate the greenhouse effect process and how if differs on the three planets. • PH ES, Comparing and Contrasting, p. 650 TE • **Ecological Footprint** Students calculate their "ecological footprint" activity at http://www.footprintnetwork.org/en/index.php/GFN/page/calculators/ OES: pending PT: pending	**PH ES**, Ch 23:2 **Holt ES**, Ch 22:2 & 27:3 ***Supplemental Resources:*** • **Activity: Exploring Exhaust** Put a white sock on the exhaust pipe of an old car and another on the tail pipe of a new car. Let the cars idle for a few minutes. ***CAUTION: Do not perform this in an enclosed area and stay well away from the exhaust fumes.*** Compare the socks after letting the • Holt ES, Demo., **Global Greenhouse**, p. 696 TE • Holt ES, Focus on the Standards, Activity, p. 697 TE ***Key Vocabulary:*** contrast astronomy feedback	4 Days

Energy in the Earth System (Ocean and Atmospheric Convection) *13% CST*

5. Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.

Content Standards (CONTENT) "Students know…"	 (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat. **(5,a)**	• Qualitatively explain the concepts of density and buoyancy. • Demonstrate how the Earth's spherical shape causes the equator to be heated more than the poles. • Explain how surface heat is transferred to the atmosphere, creating global circulation cells (atmospheric convection currents). ° Describe how hot, moist air at the equator rises. As the air rises, the pressure decreases causing the air to <u>expand and cool</u>, releasing the moisture as rain. ° Explain that as the air moves away from the equator (north or south), it eventually descends back to lower altitude where the higher pressure <u>compresses and warms</u> the air. ° Explain that to complete the cycle of the circulation cell, the dry, warm flows back to the equator, picking up moisture as it goes. • Describe how the unequal heating of the Earth's surface also causes ocean currents that redistribute heat in significant ways, citing specific examples. • Explain how heat stored in water is released when the water vapor condenses and precipitates. • Describe how all of the heat distribution mechanisms cause the equatorial regions to be somewhat cooler and the poles somewhat warmer than might otherwise be expected. • Review that the Earth's axis is tilted 23.5^o with respect to the plane of its orbit around the Sun. • Explain how different amounts of solar energy reach the north and south hemispheres at different times, causing opposite seasons. • Explain that the ocean and the atmosphere form a linked, fluid energy transfer system. ***Skills Focus:*** Protractor Use Read and interpret topographic and geologic maps. **(I&E 1.h)**	***Key Assignments:*** - none - ***Suggested:*** • **Angle of Incidence Activity** Model angle of suns rays at equator and pole with flashlight. Hold flashlight a few centimeters above paper vertically and then 30 degrees from vertical and trace light outline. How is outline different, and how does that relate to intensity of light at Earth's surface? (see p. 589) • <u>Holt ES</u>, Group Activity, **It's a Breeze**, p. 562 TE OES: pending PT: pending	**<u>PH ES</u>**, Ch 16:1, 19:1-2, 20:1, and 21:1 **<u>Holt ES</u>**, Ch 22:2-3 ***Supplemental Resources:*** • <u>PH ES</u>, **Creating Density Currents**, p. 451 • <u>PH ES</u>, **How Do Ocean Waves Form?**, p. 447 • <u>PH ES</u>, **How Gradients Influence Speed**, p. 531 • <u>PH ES</u>, Teacher Demo, **Measuring the Mass of Air**, p. 532 • <u>PH ES</u>, Teacher Demo, **Warm Air Rises**, p. 538 • <u>PH ES</u>, GEODE, **The Atmosphere: Air Pressure and Wind**, • <u>PH ES</u>, Teacher Demo, **Air Masses in a Bottle**, p. 559 • <u>PH ES</u>, Lab, **Observing How Land and Water Absorb and Release Energy**, p. 590 ***Key Vocabulary:*** buoyancy, circulation cells density, polar spherical, equatorial climate bands, hemispheres •	5 Days

Content Standards (CONTENT) "Students know…"	 (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers. **(5,b)**	• Model and explain how the eastward rotation of the Earth causes the Coriolis Effect – a deflection of fluids (air and ocean currents) to the right in the northern hemisphere and a deflection to the left in the southern hemisphere. • Explain and diagram how this causes major, global air and ocean currents to travel counter clockwise in the northern hemisphere and the opposite in the southern hemisphere. • Explain how a region of low pressure (less dense) air interacts with higher pressure (more dense) air to create storm centers that rotate in the opposite direction of the major global currents. ° Describe how air flows naturally from high pressure to low pressure.  ° Diagram how the Coriolis Effect causes air flow to miss the center of the low pressure region.  ° Explain how northern hemisphere storm centers rotate counterclockwise (to the left), when the Coriolis Effect makes wind patterns deflect to the right.  • Explain why this process creates clockwise spinning storm centers in the southern hemisphere. ***Skills Focus:*** Imagine Different Frames of Reference	***Key Assignments:*** - none - ***Suggested:*** • PH ES, Exploration Lab, **Observing Wind Patterns**, pp. 550-1 OES: pending PT: pending	**PH ES**, Ch 16:1 and 19:1-2 **Holt ES**, Ch 21:1 and 22:1,3 ***Supplemental Resources:*** • **Modeling the Coriolis Effect** Using a piece of chalk (or Vis-à-Vis erasable pen) and a globe, have students draw a line from the north pole to the equator. Repeat the process while another student slowly spins the globe to the right (toward the east for the globe). The resulting curve demonstrates how a rotating frame of reference make a straight line appear to turn. CA Sci Framework, p 267 • **Coriolis Merry Go Round Video**, Univ. of Illinois http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/fw/crls.rxml • **Coriolis Effect on Currents** http://oceanservice.noaa.gov/education/kits/currents/05currents1.html • Holt ES, Demo., **Modeling the Coriolis Effect**, p. 561 TE ***Key Vocabulary:*** Coriolis Effect, deflect frame of reference, axis counterclockwise	3 Days

<table>
<tr><th colspan="2">Content Standards</th><th rowspan="2">Perf. Std. Measures
How students DEMONSTRATE KNOWLEDGE and SKILL.</th><th rowspan="2">Instructional Support</th><th rowspan="2">Appx Time</th></tr>
<tr><th>(CONTENT)
"Students know…"</th><th>(SKILL)
"Students are able to …"</th></tr>
<tr><td>… the origin and effects of temperature inversions. (5,c)</td><td>• Explain that normally, the atmosphere is heated from below by the transfer of energy from the Earth's surface, producing a convection current.
• Define temperature inversion as an atmospheric condition where lower density warm air trapped over high-density cold air, effectively stopping convection and resulting in stagnant air.
• Diagram how temperature inversion in the Los Angeles basin concentrates the smog effects during the spring and summer.
  ° Illustrate a profile of the LA basin showing the ocean on one side and mountains on the other.
  ° Draw arrows showing cool, dense air entering the basin from the ocean and warm, less dense air from the high desert forming a stagnant inversion layer which quickly fills with pollutants.

Skills Focus:
Diagram

Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. (I&E 1.m)</td><td>Key Assignments:
• World Famous Smog (possible)
Students research the cause of the temperature inversion and smog production in the Los Angeles basin as well as the efforts to mitigate smog over the past 50 years.
[further guidelines on p. 43]

Suggested:
• LA Smog
Illustrate a profile view of the LA basin showing the ocean on one side and mountains on the other. Draw arrows showing cool, dense air entering the basin from the ocean and warm, less dense air from the high desert forming a stagnant inversion layer. Show sources of the pollutants that quickly fill the LA basin.

OES: pending
PT: pending</td><td><u>PH ES</u>, Ch 18:2-3
(feature on p. 523)

<u>Holt ES</u>, Ch 22:1 (p. 554)

Supplemental Resources:
• Inversion Layers and Smog
http://daphne.palomar.edu/cal environment/smog.htm#more %20information

Key Vocabulary:
convection, topography
stagnant, basin
smog, temperature inversion</td><td>2 Days</td></tr>
</table>

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms. **(5,d)**	• Identify temperature and salinity as major properties of ocean water. • Explain why the density of water increases as it cools, but decreases as it freezes. • Explain that it is the differences in density that causes the cold polar water to sink and flow back to the warm equatorial regions where the warmer, less dense water is rising. • Explain that between the poles and the equator the water is layered with the warm water on top and the cold water below. • Define specific heat as the ability to hold heat. • Explain that the high specific heat of water transport heat from the equator to the poles and acts to buffer the Earth's surface against significant temperature and climate changes. • Explain that water is an excellent solvent for many ions and dissolved gases necessary to sustain marine life. • Explain how water near the surface is oxygenated by photosynthesis. • Explain how dissolved nutrients required by phytoplankton are depleted. ◦ Describe the process of zooplankton eating phytoplankton, and the remains sinking into deeper waters where they decompose, depleting the oxygen and enriching the nutrients. ◦ Describe the convective process by which deep water rises to the surface carrying nutrients needed by phytoplankton, starting the process over again. • Explain how wind drives surface water. • Explain how ocean currents influence regional climates (e.g., the Gulf Stream warming western Europe). ***Skills Focus:*** Analyze Causes and Effects Analyze situations and solve problems that require combining and applying concepts from more than one area of science. **(I&E 1.l)**	***Key Assignments:*** - none - ***Suggested:*** • PH ES, Inquiry Activity, **How Does Salinity Affect the Density of Water?** p. 421 OES: pending PT: pending	**PH ES**, Ch 15:1-2 and 16:1 **Holt ES**, Ch 20:1 ***Supplemental Resources:*** • **Density Currents Demo: Changing Temp. & Salinity** CA Sci Framework, p 269 • Discovery Channel Video: Ch. 15, **Predators and Prey** • PH ES, Video Fieldtrip, **Ocean Water & Ocean Life** • PH ES, Teacher Demo., **Solar Incidence Angles**, p. 424 TE • Holt ES, Motivate Activity, **Losing Fizz**, p. 493 TE • Holt ES, SciLinks, **Properties of Ocean Water**, www.scilinks.org SciLInks code: HQ61232 • Holt ES, QuickLab, **Dissolving Solids**, p. 495 ***Key Vocabulary:*** salinity, phytoplankton specific heat, zooplankton oxygenated, density thermocline, mixed zone	5 Days

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… rain forests and deserts on Earth are distributed in bands at specific latitudes. **(5,e)**	• Show on a globe where the bands (or zones) of similar climate encircling the Earth. • Explain how these bands are produced by large-scale convective air patterns, called "Hadley cells". ° Diagram how the Hadley cells are formed by air rising at the equator and 60° (north and south) latitude, and sinking at 30° (north and south) and at the poles. ° Explain how sinking air is compressed because gravity's pull on the overlying air, which warms the air. ° Explain how rising air expands and cools. (This effect can be observed when gases are cooled as they expand rapidly out of an aerosol can or compressed gas cylinder.) ° Explain that because the compressed, warm air can hold more water, it pulls more water off of the land and makes deserts common in bands of sinking air. ° Explain how the expanding and cooling of rising air makes it release its moisture causing high precipitation and rainforests in bands of rising air. ***Skills Focus:*** Read and interpret topographic and geologic maps. **(I&E 1.h)**	***Key Assignments:*** - none - ***Suggested:*** • PH ES, Map Master Skills: **Global Climates**, pp. 594-5 OES: pending PT: pending	**PH ES**, Ch 19:2 and 21:2 **Holt ES**, Ch 25:2 [Hadley cells are not mentioned] ***Supplemental Resources:*** • PH ES, Teacher Demo. **Differential Heating**, p. 544 TE • Discovery Channel Video: **Polar Weather** • **Hadley Cells** http://en.wikipedia.org/wiki/Hadley_cell • **Climate Zone Cells** http://sparce.evac.ou.edu/q_and_a/air_circulation.htm • Holt ES, Activity, **Adaptations**, p. 638 TE ***Key Vocabulary:*** Hadley cell gravity encircle	3 Days

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the interaction of wind patterns, ocean currents, and mountain ranges results in the global pattern of latitudinal bands of rain forests and deserts. ***(5,f*)***	• *Explain that tropical air is warmed (by more perpendicular sunlight rays near the equator) and evaporates water, and that this warm, moist air rises.* • *Explain that as the warm air rises it cools and can no longer hold as much moisture and that the moisture precipitates as rain.* • *Explain how the cooled dry air then gets pushed to the north or south by still rising currents of warm moist air.* • *Explain how the cool, dry air slowly descends as it moves away from the equator eventually reaching the ground at about 30^o latitude where it is heated by the warm ground, picking up the land's moisture and producing a desert.* • *Identify evidence of similar effects between 60^o latitude (temperate rain forests) and the poles.* • *Explain how rain shadow deserts are also found outside the latitudinal band of deserts, (such as much of Nevada, east of the Sierra Nevada mountains).* ◦ *Explain that the presence of mountains physically forces air to rise and drop rain on one side.* ◦ *Explain how the cool, dry air passes over the mountain and is compressed and heated on the far side of the mountain as it descends again, producing desert conditions.* ***Skills Focus:*** Model, Infer Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • **Finding Shadows** Have students locate deserts next to mountain ranges on a world map. Have students infer the direction of prevailing winds across these mountains. • PH ES, Quick Lab, **Observing How Land and Water Absorb and Release Energy**, p. 590 OES: pending PT: pending	**PH ES**, Ch 21:1-2 **Holt ES**, Ch 25:1-2 ***Supplemental Resources:*** • **NSTA SciLinks** (Holt ES) Topic: **Climates of the World** SciLinks code: cjn-6212 www.scilinks.org • **NOAA Current Global Satellite Data**: *(Note: temperatures are recorded in Kelvin scale [Celcius + 273])* http://www.osdpd.noaa.gov/ml/index.html • **NOAA Education:** http://www.education.noaa.gov/ • **NASA Earth Observatory:** http://earthobservatory.nasa.gov/Observatory/# • Holt ES, SciLinks, **What Affects Climate**, SciLInks code: HQ61232 ***Key Vocabulary:*** deserts rain forests	3 Days
… features of the ENSO (El Niño southern oscillation) cycle in terms of sea-surface and air temperature variations across the Pacific and some climatic results of this cycle. ***(5,g*)***	• *Explain how periodic changes in patterns of temperature and air pressure of the equatorial Pacific Ocean and overlying air masses cause ENSO.* • *Explain how these changes effect global weather patterns.* ***Skills Focus:*** Recognize the cumulative nature of scientific evidence. **(I&E 1.k)**	***Key Assignments:*** • **Living with El Niño** (possible) Students research the causes and impacts of El Niño currents along the west coasts of north, central, and south America. *[further guidelines on p. 43]* ***Suggested:*** OES: pending PT: pending	**PH ES**, Ch 19:3 **Holt ES**, Ch 25:1 ***Supplemental Resources:*** • PH ES, Activity, **Tracking El Nino from space**, p. 549 TE • **El Nino – PBS:** http://www.pbs.org/wgbh/nova/elnino/index.html • **NOAA – El Nino Education:** http://www.elnino.noaa.gov/ ***Key Vocabulary:*** El Niño variations overlying	2 Days

Energy in the Earth System (Climate and Weather) *8% CST*

6. Climate is the long-term average of a region's weather and depends on many factors.

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… weather (in the short run) and climate (in the long run) involve the transfer of energy into and out of the atmosphere. **(6,a)**	• Explain how unequal transmission and absorption of solar energy cause differences in air temperature and pressure, generating winds. • Explain how humidity is determined by evaporation and precipitation of water. • Explain why energy is released when water precipitates (raising surrounding temperature) and is absorbed when water evaporates (cooling the surroundings). • Describe how energy is transferred between atmosphere and oceans through evaporation and precipitation. • Define climate as the long-term, average weather of a region. ***Skills Focus:*** Observe Select and use appropriate tools and technology to perform tests, collect data, analyze relationships, and display data. **(I&E 1.a)**	***Key Assignments:*** • **Mini-Weather Station (6a,b)** [See description on p. 44.] ***Suggested:*** • PH ES, Activity, Applying Concepts, p. 486 TE • Holt ES, Quick Lab, **Wind Chill**, p. 612 [Point out how energy is absorbed to evaporate water, lowering surrounding temp. Help students make the logical connection that condensing water (as when precipitation occurs) releases energy and raises the surrounding temp.] OES: pending PT: pending	**PH ES**, Ch* 17:2 and 21:1 **Holt ES**, Ch 24:1,3 and 25:1 ***Supplemental Resources:*** ***Key Vocabulary:*** weather, climate, humidity, atmosphere, relative humidity, evaporation, dew point, precipitation, fog, condensation	3 Days
… the effects on climate of latitude, elevation, topography, and proximity to large bodies of water and cold or warm ocean currents. **(6,b)**	• Explain how temperatures at higher elevations are lower because of the expanding and cooling of air. • Explain examples of how climate is influenced by the presence of mountains, including rain shadow effect, monsoon cycle, and Santa Ana winds. • Explain how the specific heat of water causes regions near large bodies of water to be generally cooler than inland regions during warm weather and warmer during cold weather. • Explain how the proximity of land to large bodies of water influences climate through both warm and cold currents. ***Skills Focus:*** Research, Interpret Data Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. **(I&E 1.m)**	***Key Assignments:*** • **Mini-Weather Station (6a,b)** [See description on p. 44.] ***Suggested:*** • PH ES, Quick Lab, **Observing How Land and Water Absorb and Release Energy**, p. 590 • Holt ES, Motivate, **Using the Figure**, p. 631 TE [Also locate the cities on a map and discuss why the difference in temperature ranges.] OES: pending PT: pending	**PH ES**, Ch 16:1, 19:3 and 21:1-2 **Holt ES**, Ch 25:1-2 ***Supplemental Resources:*** • PH ES, Teacher Demo., **Heating Angles**, p. 589 TE • PH ES, Lab Manual, p. 141, **Measuring the Angle of the Sun at Noon** • Holt ES, Demo., **Latitude and Temperature**, p. 632 ***Key Vocabulary:*** latitude, specific heat, elevation, polar zone, topography, temperate zone, monsoon, tropics	2 Days

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how Earth's climate has changed over time, corresponding to changes in Earth's geography, atmospheric composition, and other factors, such as solar radiation and plate movement. **(6,c)**	• Identify geologic eras in which the global climate was warmer and colder that the present global climate. • Explain how changes in the tilt of the earth and the shape of Earth's orbit over thousands of years influence climate. • Identify how the current configuration of land masses influences climate by directing ocean currents (i.e., the Gulf Stream). • Hypothesize how continental drift might impact global climate based on their influence on ocean and air currents and the regional effects of moving through different latitudes. • Explain how dust and volcanic ash from major volcanic eruptions and meteorite impacts can influence climate. • Discuss how human activity might influence climate (i.e., the greenhouse effect). ***Skills Focus:*** Cite Evidence, Debate Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. **(I&E 1.m)**	***Key Assignments:*** • **Global Climate Change Research** [4c, 6b-d*] (possible) Students research both historic patterns and current trends in global climate change. *[further guidelines on p. 43]* ***Suggested:*** • PH ES, Map Master Skills Activity, **The Breakup of Pangaea**, p. 378 • PH ES, Quick Lab, **Relative Dating**, p. 372 OES: pending PT: pending	**PH ES**, Ch 13:2 and 21:3 **Holt ES**, Ch 25:3 ***Supplemental Resources:*** • PH ES, Teacher Demo., **Forming the Rocky Mountains**, p. 378 TE • Holt ES, Internet Activity, **Climate Models**, p. 642 TE ***Key Vocabulary:*** radiation, axis, dynamic, global warming, era, episode, astronomical, deforestation	4 Days
… how computer models are used to predict the effects of the increase in greenhouse gases on climate for the planet as a whole and for specific regions. ***(6,d*)***	• *Explain that computer models suggest that accumulation of greenhouse gases (including water vapor, carbon dioxide, methane, and some nitrogen oxide pollutants) in the atmosphere will raise global temperatures.* • *Explain that Earth is kept warmer than it would otherwise be, because greenhouse gases allow energy from the Sun in, but slow the loss of heat back into space.* • *Describe ways human activity can increase the amount of greenhouse gases.* • *Explain that the buildup of greenhouse gases could affect global temperatures and weather patterns, but predicting long-term effects is difficult because the Earth has many complicated and sometimes poorly understood feedback mechanisms.* ***Skills Focus:*** Compare and Contrast Recognize the cumulative nature of scientific evidence. **(I&E 1.k)**	***Key Assignments:*** • **Greenhouse Effect** (possible) [6d* 4b,c,d*] Students explore and present the technology and people who have explored the furthest reaches of the universe. *[further guidelines on p. 43]* ***Suggested:*** • PH ES, Exploration Lab, **Human Impact on Climate and Weather**, pp. 606-7 OES: pending PT: pending	**PH ES**, Ch 21:3 **Holt ES**, Ch 22:2 ***Supplemental Resources:*** • PH ES, Use Visuals, **Fig. 16**, p. 602 TE • Holt ES, Ch Resource File, (or Internet Activity at go.hrw.com keyword: H!6ATMX), **Global Warming**, description on p. 558 TE ***Key Vocabulary:*** global effects, regional effects	2 Days

Biogeochemical Cycles **8% CST**

7. Each element on Earth moves among reservoirs, which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles.

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the carbon cycle of photosynthesis and respiration and the nitrogen cycle. **(7,a)**	• Diagram biological carbon cycles in various habitats. ° Explain how carbon, as CO_2, is brought into the biosphere through photosynthesis and is released again into the atmosphere through respiration. • Describe and explain various geologically linked (biogeochemical) carbon cycles. ° Describe how carbon is dissolved and stored in the ocean as carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) ions where it is used by certain organisms to make their shells. ° Explain how shells may eventually dissolve back into the ocean or settle to the ocean floor and become part of the sediment, eventually forming a carbonate rock, such as limestone. ° Describe how carbonate rocks may be uplifted over time and dissolved by acid rain or heated so that carbon dioxide reenters the atmosphere. ° Describe how carbonate rocks may be subducted, decomposed by high temperatures, and returned to the atmosphere as volcanic CO_2 gas. ° Identify various ways carbon is stored in the solid Earth: as graphite, methane gas, petroleum, or coal. • Explain how the nitrogen cycle brings the most common element in the atmosphere, N_2, into and out of the biosphere. ° Describe how only certain, specialized bacteria are able to take in atmospheric N_2 and "fix" it by converting it into ammonia (NH_3). ° Recall that other bacteria change the ammonia into nitrite (NO_2^-) and then to nitrate (NO_3^-), which plants are able to use as food and pass along to other organisms in the biosphere. ° Explain how decomposer bacteria reverse this process, returning N_2 to the atmosphere. ***Skills Focus:*** Analyze situations and solve problems that require combining and applying concepts from more than one area of science. **(I&E 1.l)**	***Key Assignments:*** - none - ***Suggested:*** • PH ES, Earth as a System, **The Carbon Cycle**, p. 85 [note the Teaching Tips in TE] OES: pending PT: pending	**PH ES**, Ch 3:4 and 5:2 **Holt ES**, Ch 2:2 and 22:1 ***Supplemental Resources:*** • **The Carbon Cycle Game** www.enviroliteracy.org/article.php/1191.php • **The Carbon Cycle Information** www.enviroliteracy.org/article.php/478.html • Holt ES, SciLinks, Topic: **Carbon Cycle**, SciLInks code: HQ60216 • Holt ES, SciLinks, Topic: **Nitrogen Cycle**, SciLInks code: HQ61036 ***Key Vocabulary:*** atmosphere, sediment, carbon, nitrogen	4 Days

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the global carbon cycle: the different physical and chemical forms of carbon in the atmosphere, oceans, biomass, fossil fuels, and the movement of carbon among these reservoirs. **(7,b)**	• Identify the reservoirs of carbon within the Earth's biological and physical systems. ◦ Recall that carbon appears primarily as CO_2 in the atmosphere. ◦ Recall that carbon is found as dissolved CO_2, and as carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) ions in the oceans. ◦ Identify how carbon appears in living organisms (biomass) as sugar and many other organic molecules. • Identify biological and physical means of moving carbon from one reservoir to another. • Explain how burning fossil fuels to produce energy has increased the rate of returning CO_2 to the atmosphere, increasing its concentration in the atmosphere. • Explain how the burning of fossil fuels may impact climatic conditions. (Refer to the last bullet point in the Task Analysis for standard 6d*.) ***Skills Focus:*** Predict Effects Recognize the issues of statistical variability and the need for controlled tests. **(I&E 1.j)**	***Key Assignments:*** • **Energy Research/Debate** (possible) [7b,d* 4a] Students make a chart to compare the cost of using fossil fuels to the cost of converting solar energy. Include both monetary and non-monetary costs. Follow up with a debate over different sources of energy for society. Alternatively, students can make energy resource presentations as if to influence policy at the state or federal level. *[further guidelines on p. 43]* ***Suggested:*** OES: pending PT: pending	**PH ES**, Ch 3:4 **Holt ES**, Ch 2:2 ***Supplemental Resources:*** • **Activity: Greenhouse Investigations** Under each of three identical bell jars, place an opened soda can. Fill one of the soda cans with water, leave one empty, and have the third be a freshly opened, ambient temperature soda. Heat by exposing to identical light sources. Using temperature probes or high quality thermometers, record temperature increases at regular time intervals. • **Carbon Cycle (University of Colorado)** http://www.colorado.edu/geolsci/courses/GEOL3520/Carbon%20cycle.pdf • **Biogeochemistry and the Carbon Cycle** http://earthguide.ucsd.edu/virtualmuseum/climatechange1/05_1.shtml ***Key Vocabulary:*** biogeochemical process greenhouse effect climate biomass fossil fuels reservoirs	4 Days
… the movement of matter among reservoirs is driven by Earth's internal and external sources of energy. **(7,c)**	• Explain how the movement of carbon between reservoirs requires an input of either solar or geothermal (Earth's internal heat) energy. ◦ Explain how the Sun's energy drives photosynthesis. ◦ Explain how energy from Earth's interior drives subduction and volcanic magma upwelling. ***Skills Focus:*** Diagram Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • **Activity: Charting BGC Connections** Have students create a diagram showing the interconnected biogeochemical processes, indicating energy sources and conversions. OES: pending PT: pending	**PH ES**, Ch 3:4 **Holt ES**, Ch 2:2 ***Supplemental Resources:*** ***Key Vocabulary:*** reservoir biogeochemical	2 Days

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the relative residence times and flow characteristics of carbon in and out of its different reservoirs. ***(7,d*)***	• *Explain why carbon moves at different rates between reservoirs.* ◦ *Explain photosynthesis and respiration make the residence times of carbon in biological reservoirs short.* ◦ *Contrast the residence time in biomass with that of geological processes, such as storage in coal beds and the slow return to the atmosphere by the oxidation of exposed coal beds during weathering processes.* • *Identify steps responsible for both short and long residence time elements as carbon moves between reservoirs.* ***Skills Focus:*** Comparing and Contrasting Analyze situations and solve problems that require combining and applying concepts from more than one area of science. **(I&E 1.l)**	***Key Assignments:*** - none - ***Suggested:*** • **Activity: Life in the Fast Lane** Students create a hypothetical progression of a carbon atom moving through reservoirs ending up in the same for it began. This is made into a timeline on strips of paper which are connected into a loop. OES: pending PT: pending	**PH ES**, Ch 3:4 and 5:2 **Holt ES**, Ch 2:2 and 22:1 ***Supplemental Resources:*** • **Carbon Cycle (University of Colorado)** http://www.colorado.edu/geolsci/courses/GEOL3520/Carbon%20cycle.pdf • **Global Carbon Reservoirs, Fluxes and Turnover Times** http://www.ess.uci.edu/~reeburgh/fig1.html ***Key Vocabulary:*** residence time reservoir	3 Days

Structure and Composition of the Atmosphere *8% CST*

8. Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life.

Content Standards		Perf. Std. Measures	Instructional Support	Appx Time
(CONTENT) "Students know…"	(SKILL) "Students are able to …"	How students DEMONSTRATE KNOWLEDGE and SKILL.		
… the thermal structure and chemical composition of the atmosphere. **(8,a)**	• Recall that the atmosphere is a mixture of gases: 78% N_2, 21% O_2, 1% Ar, and traces of other gases including water vapor and CO_2. • Explain that, just as gravity causes water to become denser with under its own weight at depth, so the atmosphere is most dense at the Earth's surface and get less dense as elevation increases. • Identify the four layers of the atmosphere classified according to their temperature gradient. ◦ Identify the troposphere, in which temperature decreases with altitude. ◦ Identify the stratosphere, in which temperature increases with altitude. ◦ Identify the mesosphere, in which temperature decreases again with altitude. ◦ Identify the thermosphere (a.k.a, ionosphere), as the outermost layer in which temperature increases again with altitude. • Describe the properties of each atmospheric layer. ◦ Explain that all weather occurs in the troposphere. ◦ Describe how life is sustained by the concentration of gases in the lower troposphere. ◦ Describe the composition of the stratosphere as similar to the troposphere, except that there is virtually no water. ◦ Explain that the stratosphere is biologically important in that solar radiation causes O_2 in the stratosphere to break up and form ozone (O_3), which absorbs harmful ultraviolet radiation. ◦ Describe the mesosphere as very low density and many of the molecules present are ionized by solar radiation. ◦ Describe the thermosphere as containing almost no air and exposed to the direct rays of the Sun. ◦ Explain how the thermosphere illustrates the difference between heat and temperature, because although very little heat energy is absorbed, it causes the few molecules of the thermosphere to move extremely fast (have a high temperature). ***Skills Focus:*** Graph to Scale Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)**	***Key Assignments:*** - none - ***Suggested:*** • **Graph & Analysis of Air:** Students graph the relative amounts of the components of air in a method of their choice and use the graph as a basis for developing questions to investigate, such as, "Where did the argon come from?" and "If CO_2 is only a trace component, why is everyone so concerned about it?" and "What would happen if air were mostly O_2?" OES: pending PT: pending	**PH ES**, Ch 17:1 **Holt ES**, Ch 22:1-2 ***Supplemental Resources:*** • **Oxygen Content of Air:** Place a short candle in a shallow pie tin, half filled with water. Light the candle and place an inverted glass beaker or graduated cylinder over the candle. Observe the change in volume, roughly corresponding to the amount of O_2 consumed. *(Note to teacher: Some of the volume loss is caused by thermally expanded air escaping out of the bottom and much of the CO_2 produced is included in the gas volume. SO, it is a very rough correlation. Don't bother calculating a % of O_2 from this.)* • PH ES, Activity, **Height and Structure of the Atmosphere**, p 479 TE • Holt ES, Quick Lab, **Barometric Pressure**, p 551 [Consider using balloon instead of the plastic wrap suggested in the book.] ***Key Vocabulary:*** geologic time scale outgassing, ozone thermosphere, evolution troposphere, stratosphere mesosphere, ionosphere	4 Days

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
…how the composition of Earth's atmosphere has evolved over geologic time and know the effect of outgassing, the variations of carbon dioxide concentration, and the origin of atmospheric oxygen. **(8,b)**	• Explain how scientists use a combination of evidences from geological, biological, and astronomical sources to construct models that explain the evolution of Earth's atmosphere. • Explain how, when the Sun's fusion began, strong solar winds would have driven away any early atmosphere on Earth. • Describe how, eventually, an atmosphere formed by a combination of gases released from the Earth (mostly from volcanoes) and from materials brought to Earth by comet and asteroid collisions. • Explain how chemical reactions in the presence of water, over time, changed methane (CH_4) and ammonia (NH_3) into nitrogen (N_2), Hydrogen (H_2), and carbon dioxide (CO_2). • Explain that the hydrogen was lost, because hydrogen gas has so little mass, it gets pushed to the top of the atmosphere and escapes into space. • Explain how the appearance of photosynthetic life removed CO_2 from and added O_2 to the atmosphere. • Recall that the atmosphere is believed to have had roughly the current balance of gases for the last 600 million years. • Explain that while small changes in the amount CO_2 have occurred naturally over time, there appear to be significant increases occurring in modern times attributed to human activities. ***Skills Focus:*** Research Distinguish between hypothesis and theory as scientific terms. **(I&E 1.f)**	***Key Assignments:*** - none - ***Suggested:*** • **Atmospheric Time Scale** Create a geologic time scale visual that shows how the life forms or each era changed the Earth's atmosphere. Use evidence from glacial core chemical samples. • Holt ES, Graphic Organizer, **Chain-of-Events Chart**, p 688 OES: pending PT: pending	**PH ES**, Ch 13:1 **Holt ES**, Ch 27:1 ***Supplemental Resources:*** • **The Atmosphere: Origin and Structure** [Eastern Illinois Univ.] http://www.ux1.eiu.edu/~cfjps/1400/atmos_origin.html ***Key Vocabulary:*** geologic time scale ozone ultraviolet rays methane ammonia	5 Days

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the location of the ozone layer in the upper atmosphere, its role in absorbing ultraviolet radiation, and the way in which this layer varies both naturally and in response to human activities. **(8,c)**	• Explain how catalysts modify the rate of reactions without being consumed, in their own words. • Write the chemical equation showing the formation and breakdown of ozone, $3O_2 \rightleftharpoons 2O_3$ (oxygen, ozone) explaining the causes for each direction. • Explain how the concentrations of ozone and oxygen reach equilibrium in the stratosphere when ozone is formed by incoming radiation as fast as it is broken down by ultraviolet radiation. • Explain that chlorofluorocarbons (CFCs) greatly increase the rate of breaking down ozone to oxygen, and therefore may be causing a change in the equilibrium. • Explain how reducing the ozone in the stratosphere would allow more ultraviolet radiation to reach the surface of the Earth, causing greater damage to plants and animals. • Give evidence supporting the idea that ozone is both beneficial and harmful, depending on where it is found. ***Skills Focus:*** Research, Write Complete Eqns Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. **(I&E 1.m)**	***Key Assignments:*** • **Ozone Layer** (possible) Students research history of upper atmosphere research and the implications of changes in the ozone layer. *[further guidelines on p. 43]* ***Suggested:*** • Holt ES, Graphic Organizer, **Chain-of-Events Chart**, p 688 OES: pending PT: pending	**PH ES**, Ch 4:3 and 17:1,3 **Holt ES**, Ch 22:1-2 ***Supplemental Resources:*** • **Manganese Dioxide reaction** Pour peroxide (H_2O_2) into a test tube containing manganese dioxide (MnO_2) to show how the peroxide quickly decomposes to water and oxygen, while the MnO_2 remains unchanged – and can be used over and over again. [Note: dry the MnO_2, do not discard it.] • **Good Up High, Bad Nearby** [Environmental Protection Agency] http://www.epa.gov/oar/oaqps/gooduphigh/ ***Key Vocabulary:*** catalyst, triatomic diatomic, halogens ozone, photochemical chlorofluorocarbons (CFC's)	3 Days

California Geology

8% CST

9. The geology of California underlies the state's wealth of natural resources as well as its natural hazards.

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the resources of major economic importance in California and their relation to California's geology. **(9,a)**	• Explain how tectonic activity in California is responsible for creating valuable economic resources (including, ore deposits, oil, natural gas, and the agricultural abundance of the central valley). • Explain how subduction is responsible for creating valleys, mountain ranges, and geothermal energy release. • List the economically significant material and energy resources in California and explain their relationship to geological processes. ***Skills Focus:*** Research, Evaluate Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include choice of energy sources, and land and water use decisions in California. **(I&E 1.m)** [*Investigating careers in Resource Management*] Know important strategies for self-promotion in the hiring process, such as job applications, resume writing, interviewing skills, and preparation of a portfolio. **(FS 3.6)** Understand the role of personal integrity and ethical behavior in the workplace. **(FS 8.3)**	***Key Assignments:*** • **Mineral Lab** [See description on p. 44.] • **California Resources** (possible) Students research and identify the locations and applications of mineral and fossil fuels in California, addressing the monetary and ecological costs of making these resources available. *[further guidelines on p. 43]* ***Suggested:*** • PH ES, Inquiry Activity, **How are some of California's Minerals Used?**, p. CA3 • PH ES, Application Lab, **Finding the Product that Best Conserves Resources**, p. 118 OES: pending PT: pending	**PH ES**, Ch 13A:1 and 4:2 **Holt ES**, Ch 4 (p. 100) and C18 – C21 ***Supplemental Resources:*** • PH ES, Teacher Demo., **Panning for Gold**, p. CA7 • PH ES, Teacher Demo., **Hydroelectric Power**, p 105 TE • **CA Mineral Resource Mapping:** http://www.conservation.ca.gov/cgs/mineral_resource/Pages/Index.aspx • **Mineral-Forming Processes:** http://marine.usgs.gov/fact-sheets/gorda/index.html ***Key Vocabulary:*** ore geothermal economic resource	5 Days

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
…the principal natural hazards in different California regions and the geologic basis of those hazards. **(9,b)**	• Describe the different natural hazards present in California including faulting, landslides, coastal erosion, volcanoes, and the potential for seismic sea waves. • Identify regions subject to the various natural hazards on a map of California. • Diagram the geologic processes responsible for the various natural hazards. ***Skills Focus:*** Research, Evaluate Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. **(I&E 1.m)**	***Key Assignments:*** • **San Andreas Fault Research** [9b,d*] (possible) Students research the San Andreas fault system relative to the underlying plate boundary and describe the various hazards associated with different regions along the fault system. *[further guidelines on p. 43]* ***Suggested:*** • PH ES, Exploration Lab: **Mapping Earthquake Hazards**, pp. CA 27- 29 OES: pending PT: pending	**PH ES**, Ch 13A:3, 11:3 and 5:3 **Holt ES**, Ch 12:1-3 and C22 – C25 ***Supplemental Resources:*** • PH ES, Teacher Demo., **Modeling Liquefaction**, p. CA 23 • **California Hazard Zones:** http://www.conservation.ca.gov/cgs/geologic_hazards/regulatory_hazard_zones/Pages/Index.aspx • **San Andreas Fault:** http://pubs.usgs.gov/gip/earthq3/ what.html • **Volcano Hazards:** http://vulcan.wr.usgs.gov/Hazards/Publications/FS002-97/framework.html • Holt ES, SciLinks, Topic: **Earthquakes in California**, SciLInks code: HQ7C19 ***Key Vocabulary:*** natural hazards coastal erosion seismic sea waves	2 Days

Content Standards (CONTENT) "Students know…"	(SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
…the importance of water to society, the origins of California's fresh water, and the relationship between supply and need. **(9,c)**	• Identify the origins of California's water supply: melting snow-pack from the mountain ranges, and precipitation. • Explain how the water supply in California is distributed primarily by diverting water sources in areas of high precipitation (northern California) to areas of low precipitation (southern California). • Identify and locate the California Aqueduct and the Los Angeles Aqueduct, the two major aqueducts in California including their sources and destinations. • Explain that California water is moved for agricultural and industrial purposes. ***Skills Focus:*** Research, Evaluate Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include water use decisions in California. **(I&E 1.m)** Understand the importance of accountability and responsibility in fulfilling personal, community, and workplace roles. **(FS 7.2)**	***Key Assignments:*** • **CA Water / Water Conservation** (possible) Students the political and ecological issues surrounding California's fresh water system. Students may also explore water usage and various methods of conserving water usage. *[further guidelines on p. 43]* ***Suggested:*** OES: pending PT: pending	**PH ES**, Ch 6:3 and 13A:2 **Holt ES**, Ch 15:1-2 and C16-C17 and C4-C7 ***Supplemental Resources:*** • PH ES, Demo, **Desalination**, p. CA 15 • PH ES, Quick Lab, **How Much Water Does a Household Use?"**, p. CA 18 • **Water Education:** http://water.usgs.gov/education.html http://www.watereducation.org/ • **CA Groundwater:** http://www.water.ca.gov/groundwater/ • **Measuring the Snow Pack: Forecasting Water Supply** http://www.webs.uidaho.edu/epscor/snotel/TeacherGuide/backgrounder_snow.htm • **Los Angeles Aqueduct** http://www.lib.berkeley.edu/WRCA/aqueduct.html (historical photos – click on thumbnail to enlarge and get specs) http://en.wikipedia.org/wiki/Los_Angeles_Aqueduct http://en.wikipedia.org/wiki/California_Aqueduct http://www.water.ca.gov/swp/ • **Aerial Photo of CA aqueducts** http://en.wikipedia.org/wiki/File:Kluft-Photo-Aerial-I205-California-Aqueduct-Img_0038.jpg • **California State Water Project:** http://www.water.ca.gov/swp/ • **CA Water Supply Fact Sheet:** http://water.usgs.gov/pubs/FS/FS-005-96/index.html#HDR09 ***Key Vocabulary:*** diversion aqueduct agricultural industrial	3 Days
… how to analyze published geologic hazard maps of California and know how to use the map's information to identify evidence of geologic events of the past and predict geologic changes in the future. ***(9,d*)***	• *Read and analyze published geological hazard maps.* • *Predict likely significant geological events based on past history and current data.* • *Discuss considerations important to the safety of various business and residential locations.* • *Evaluate current, local land use policies and hazard remediation measures in relation to local geological hazard information.* ***Skills Focus:*** Analyze, Evaluate, Debate Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include land use decisions in California. **(I&E 1.m)**	***Key Assignments:*** - none - ***Suggested:*** • PH ES, Exploration Lab, **Mapping Earthquake Hazards**, p. CA 27 • PH ES, Analyze and Conclude, p. CA 28-29 OES: pending PT: pending	**PH ES**, Ch 13A:3 **Holt ES**, C22 – C25 ***Supplemental Resources:*** • **California Hazard Zones:** http://www.conservation.ca.gov/CGS/geologic_hazards/regulatory_hazard_zones/Pages/Index.aspx http://www.conservation.ca.gov/cgs/shzp/Pages/Index.aspx • **National/World Seismic Hazard Maps:** http://earthquake.usgs.gov/ http://earthquake.usgs.gov/hazards/products/conterminous/2008/maps/ ***Key Vocabulary:*** geological hazard map land use policy hazard remediation measure	4 Days

KEY ASSIGNMENTS / ASSESSMENTS:

<table>
<tr><td>Key Laboratory Activities</td><td>Lab activities are selected to illustrate the key concepts of earth science. Student laboratory reports for Key Assignment labs will be based on experimental design where students investigate a testable question. Students either generate or follow procedures to collect data. They then create graphs and/or diagrams to analyze that data in order to answer the posed question. Student comprehension of the underlying concepts and processes are verified by response to written and oral questions, using key scientific vocabulary. In their write up, students will also explore applications of the underlying concepts beyond the classroom setting.</td></tr>
<tr><td>Major Written Assignments and Performance-Based Projects
(other than labs)</td><td>One or two major projects are required for this course connecting content of the earth science class to practical applications. Each of these requires students to gather information from at least three different sources representing at least three different types of resources. These projects require data collection, analysis, and interpretation of data using graphs and simple statistics. Students present their projects in both professional and creative ways.

<u>Possible projects/topics include</u>:
“Going Green” [4a- d* 5c 6c,d* 7a,b,d* 8c 9c]
Scientist Biographical Scrapbook
Asteroid Impacts: Past (and Future?) [1f]
“Exo-planets” [1g*]
Personal Nucleosynthesis Story [2c]
Exploration Technology/Cosmology [2g*]
Life Near Plate Boundaries [3b,d,e,f*]
Fossil Fuels & Energy Balance Challenges [4a, 7b,d*]
Greenhouse Effect [4b,c,d* 6d*]
Our World Famous Smog [5c]
Living with El Nino [5g*]
Climate and Climate Change [6b,c,d*, 4c]
Ozone Layer [8c]
California Resources: Mineral & Fossil Fuels [9a]
San Andreas Fault Research [9b,d*]
California’s Water Resources [9c]
Water Conservation [9c]

One of the projects includes a Service Learning element.

✓ <u>Content Project with Service Learning</u>: Students complete a project with all of the elements listed above and which also includes five hours toward the service learning graduation requirement. (Service learning is an instructional strategy that connects meaningful service experiences in the community with academic learning, personal growth, and civic responsibility. Service learning enhances what is taught in the course by extending learning beyond the classroom and providing opportunities for students to use newly acquired skills and knowledge in real-life situations in their own communities. The purpose of Service learning is to make coursework more relevant.) For the service learning component, students can become involved with alternative energy or energy conservation projects, local atmospheric monitoring or geological safety initiatives, cross-level teaching, public advocacy, or community outreach. Possible topics can range from potential asteroid impacts to the political and engineering issues related to California’s fresh water supplies. Community organizations and businesses are often good resources for students, USGS, NOAA, Jet Propulsion Labs, LB Aquarium, college and university faculty, local oil and energy companies, power and water agencies, city government offices, or the Port of Long Beach. When presenting this project, students will include evidence of their service learning and a brief reflection on the connection to the class content and how the experience has affected them personally.</td></tr>
</table>

<table>
<tr><td>Unit Tests</td><td>Unit tests include selected response questions based primarily on conceptual understanding (including data and graph interpretation), not merely factual recall. Unit tests also include short answer free-response or essay questions connecting key concepts. For example, students may answer a question about local geographic structures and regional climate which asks how the two are connected.

As applicable, teachers also include skill-based practical exams. (i.e., use of measuring devices and GPS technology, locating epicenters from seismograms, or lab practica identifying rocks and minerals with analysis of the processes which formed them.)</td></tr>
<tr><td>Comprehensive Semester Finals</td><td>Lab Earth Science has comprehensive semester finals. The second semester final covers content from the entire year.</td></tr>
</table>

KEY LABORATORY ACTIVITIES:

Our district recommends that approximately 40% of instructional time be devoted to hands-on laboratory and project-based activities. Core experiences for this course include detailed laboratories with complete write-ups on the following topics:

Solar System Formation and Structure (1a, 1b)

Students determine the diameters (in km) and distances (in km, AU, and light minutes or hours), and then determine how to demonstrate the sizes and distances outdoors. Students also create a way to represent how the differences between the inner and outer planets developed. For instance, they could blow on some dry dirt (representing the Sun's fusion lighting up) and note how the heavier pieces stay close to the blower (heavier matter) as the lighter (gas-like pieces) blow further out. They then relate this to the observed current structure of our solar system. Students should finish by using evidence to hypothesize the future development of our solar system.

Crater Lab (1f)

Students investigate the factors that affect the size of a crater by collecting data on crater sizes made in sand (flour, or salt can also be used) by various weights dropped from various heights. This information can be used to understand the dramatic effects that asteroid impacts have had in shaping the surface of planets and their moons.

Spectroscopy (2d)

Students use diffraction gratings to observe hydrogen, neon, mercury, sodium, and other elemental light sources to show the quantum energy "fingerprints" produced by various elements. Connecting this information with what they learned about the Doppler Effect (Standard 1d), students explain how scientists determine both the composition and speed of distant stellar objects.

Mapping Topography & Using Longitude and Latitude (3b, I&E 1h)

Students create topographic maps from objects (landform representations) placed in containers that can be filled up to various pre-determined levels with dyed water. These maps are then copied cardboard layers and built into a 3-D construction. Students compare the final construction to the original object and discuss the technology used to create topographic maps today and the usefulness and applications of topographic maps.

Students also use longitude and latitude to locate real geographic features on globes and flat maps. These skills will be applied not only to identifying plate boundaries and the typical structures associated with them, but also in explaining regional climate differences (ES Standard 6b) related to latitude, altitude, and proximity to various geographic features.

Rocks (3c)

Given samples of rocks from each rock type (sedimentary, metamorphic, and igneous), students analyze and classify the rock samples. Close observations are used to make inferences about what processes were experienced by each rock through time (i.e., chemical or physical weathering, amount of heating/rate of cooling, etc.). In the write up, students will trace a detailed possible history for one rock sample from each group.

Epicenter Triangulation (3d)

Students use triangulation to locate an earthquake epicenter on a map from theoretical P and S wave data for three different hypothetical seismic stations. Inquiry-based virtual applications such as www.sciencecourseware.com/virtualearthquake/ can be helpful. Students discuss why it is important to locate epicenters and catalog earthquake data for purposes of future construction and community planning.

Viscosity Lab (3e)

Students determine the relative viscosity of several unknown liquids by timing how long they take to flow a predetermined distance. They then relate that data to the kinds of volcanic eruptions that are produced by different viscosity lavas. Students explain how magma/lava viscosity ultimately determines the shapes and explosiveness of volcanoes.

Solar Heater (4b)

Students create a device that will collect solar energy and convert that energy into heat. The devices are tested and the data related to the fate of incoming solar radiation in terms of reflection, absorption, and photosynthesis.

Differential heating and Convection Currents Lab (5a)

Students measure the temperature of water and sand when being heated and then cooled to observe how different materials experience differential heating by the sun. They then observe how different temperature water separates and moves in an aquarium showing convection. From these two activities students will see how differential heating of the Earth results in circulation patterns in the atmosphere and oceans.

Climate Lab (6a,b,c,d)

Students create a hypothetical continent at a given location on the globe with certain landforms and population centers to be included. Using their knowledge of factors that affect climate, they will describe in detail the climates at various cities/locations on their continent.

INSTRUCTIONAL METHOD AND/OR STRATEGIES:

A variety of instructional strategies will be utilized to accommodate all learning styles:

Earth Science-specific Methods:

1. lectures, videos, and demonstrations
2. readings from texts, journals, and internet sites
3. laboratory experiments and detailed written laboratory reports that emphasize experimental analysis
4. pre- and post-lab discussions
5. student presentations
6. field trips and guest speakers
7. research projects and written reports

Lesson Design & Delivery:

Teachers will incorporate these components of lesson design during both direct instruction and inquiry activities. The order of components is flexible, depending on the teacher's vision for the individual lesson. For instance, the objective and purpose, while present in the teacher's lesson plan, are not made known to the students at the beginning of an inquiry lesson.

Essential **E**lements of **E**ffective **I**nstruction Model for Lesson Design Using Task Analysis	Anticipatory Set Objective Standard Reference Purpose Input Modeling Check for Understanding Guided Practice Closure Independent Practice

Some components may occur once in a lesson, but others will recur many times. Checking for understanding occurs continually; input, modeling, guided practice and closure may occur several times. There may even be more than one anticipatory set when more than one content piece is introduced.

Active Participation:

Teachers will incorporate the principles of active participation and specific strategies to ensure consistent, simultaneous involvement of the minds of all learners in the classroom. Teachers should include both covert and overt active participation strategies, incorporating cooperative learning structures and brain research. Some of the possible active participation strategies include:

COVERT	OVERT (Oral)	OVERT (Written)	OVERT (Gestures)
• Recall	• Think (Write)/Pair/Share	• Restate in Notes	• Hand Signals
• Imagine	• Idea Wave	• Response Boards	• Model with Hand Motions
• Observe	• Choral Response	• Graphic Organizers	• Stand up/ Sit down
• Consider	• Give One, Get One	• Folded Paper	• Point to Examples
	• Socratic Seminar	• Ticket Out of Class	

Diverse learning styles may be addressed by implementing combinations of the following:

Significant, Proven Strategies for ALL Science Students

- ❑ Hands-On Lab's
- ❑ Inquiry Activities
- ❑ Short/Long-term projects
- ❑ Student Presentations
- ❑ Peer Teaching
- ❑ Summarization
- ❑ Essential Questions
- ❑ Thematic Units
- ❑ Field Experiences
- ❑ Current Events
- ❑ Career Choices
- ❑ Guest Speakers

Reading Strategies in Science

- ❑ Vocabulary Development (including conceptual and non-linguistic components)
- ❑ Anticipation Guides
- ❑ Pre-teaching
- ❑ Pre-reading
- ❑ Text Structures
- ❑ Trail Markers
- ❑ Reciprocal Teaching
- ❑ Functional Text

SDAIE Strategies for English Learners

- ❑ Lower the Affective Filter (including Processing Time)
- ❑ Tapping/Building Prior Knowledge (Graphic Organizers, Schema)
- ❑ Acquisition Levels
- ❑ Language Sensitivity
- ❑ Grouping Strategies
- ❑ Multiple Intelligences
- ❑ Adapt the Text
- ❑ Manipulatives & Visuals
- ❑ Home/School Connection (including Cultural Aspects)

Strategies for Students with Disabilities

- ❑ IEP Accommodations (refer to student's IEP document or IEP summary sheet)
- ❑ Curricular Adaptations (e.g., quantity, input, participation, time, level of difficulty, level of support, output, substitute curriculum, alternate goals)
- ❑ Think Alouds
- ❑ Small Group Instruction / Learning Centers
- ❑ Manipulatives & Visuals
- ❑ Peer Assisted Learning

Differentiation for Advanced Learners

- ❑ Curriculum Compacting
- ❑ Depth and Complexity
- ❑ Flexible Grouping
- ❑ Acceleration
- ❑ Tiered Assignments
- ❑ Independent Study

Please note that these strategies often overlap and should not be limited to specifically defined courses or student populations.

TEXTBOOKS:

Basic Textbook:	☑ Read in entirety	☐ Excerpts used	Prentice Hall Earth Science, Tarbuck and Lutgens Prentice Hall © 2006
Alt. Basic Textbook:	☑ Read in entirety	☐ Excerpts used	Holt Earth Science, Allison, DeGaetano, and Pasachoff Holt, Rinehart, and Winston © 2007

SUPPLEMENTAL INSTRUCTIONAL MATERIALS:

In addition to the basic text, a variety of instructional tools will be used to meet the needs of all students

Safety Equipment:	goggles, fire extinguisher, eye wash station
Measuring Devices:	decigram balances, mm rulers, triple beam balances, compasses (both types)
Other Laboratory Equip:	diffraction gratings, microviewers, hand lenses, thermometers, psychrometers, mineral test kits, glassware, and tubing
Laboratory Supplies:	gas tubes for spectral analysis, clay, rock samples
Other:	globes, computer-based software and hardware, including computer labs, internet access, word processing and presentation programs, and student tutorials/practice.

- ❖ Many items – including rock, mineral, and fossil sets, sediment filtration screens, stream table, hot plates, glassware, posters, and videos – are available through Science/Math Resource Center (SMRC).

RESOURCES:

Documents

- ❑ Science Framework: .... http://www.cde.ca.gov/ci/cr/cf/documents/scienceframework.pdf
- ❑ CST / NCLB Test Blueprints: .... http://www.cde.ca.gov/ta/tg/sr/blueprints.asp
- ❑ CST Reference Sheets: .... http://www.cde.ca.gov/ta/tg/sr/cstsciref.asp
- ❑ National Science Standards: .... http://www.nap.edu/openbook.php?isbn=0309053269
- ❑ Science Safety Handbook for CA Public Schools (1999) can be ordered from the CDE at .. http://www.cde.ca.gov/pd/ca/sc/documents/scisafebk.pdf
- ❑ LBUSD Approved Chemicals List, Chemical Hygiene Plan, and Science Fair Resources: at LBUSD website, Science/Teacher Resources

ASSESSMENT METHODS AND/OR TOOLS:

Student achievement in this course will be measured using multiple assessment tools including but not limited to:

Suggested Evaluation Tools:

Source	Diagnostic	Formative	Summative
District Level Assessments	Grade Level Pretest	Open-Ended Science Performance Task	End of Course Exam Open Ended Science
Prentice Hall, Earth Science	Inquiry Activities Section Reading Strategies Problem Solving Activities Address Misconceptions	Section Assessments Connecting Concepts Chapter Reviews Standardized Test Prep	Chapter & Unit Assessments Labs, and Lab Writing Ups Projects
Holt, Earth Science	Bellringer Motivate Activities Misconception Alerts	Section and Chapter Reviews Graphic Organizers Alternative Assessments Quick Lab: Analysis Chapter Standards Assessments	Chapter & Unit Assessments Labs, and Lab Writing Ups Projects
Teacher Developed Assessments	Accessing Prior Knowledge Activities Pre-quiz Pre-Test Vocab. Knowledge Rating	Warm-Up Quiz Proving Behavior Lab	Open-ended Prompts Chapter / Unit Test Practicum Semester Final Exam

PERFORMANCE STANDARDS:

Defines how good is good enough on which measures to demonstrate achievement of content standards.

State Performance Standards:

The California State Board of Education has identified the following performance levels for the California Standards Test (CST) in Biology/Life Sciences. The objective of Long Beach Unified School District is to have all students achieve at or above the Proficient Performance Standard (Level). The table below indicates the number correct, the estimated percent correct (based on 2009 data) and the Reported Scaled Score (SS) on the Content Standards Test.

Far Below Basic	Below Basic	Basic	Proficient	Advanced Proficient
SS 150 – 276	**SS 277 – 299**	**SS 300 – 349**	**SS 350 – 392**	**SS 393 – 600**
0-20 Correct	**21-26 Correct**	**27-40 Correct**	**41-49 Correct**	**50-60 Correct**
Less than 35%	**35% - 43%**	**45% - 67%**	**68% - 82%**	**83% - 100%**

District Performance Standards:

The Long Beach Unified School District has common assessments and key assignments that are required for Biology. The Performance Standard Criteria for district-wide and classroom setting are shown in the table below.

	Not Proficient	Partial Proficient	Proficient	Advanced Proficient
End-Of-Course Exam	**Less than 60%**	**60% - 69%**	**70% - 84%**	**85% - 100%**
Constructed Response	(6 pt rubric) **1-2** (4 pt rubric) **1**	(6 pt rubric) **3** (4 pt rubric) **2**	(6 pt rubric) **4** (4 pt rubric) **3**	(6 pt rubric) **5-6** (4 pt rubric) **4**

Classroom Performance Standards:

The objective of instruction is to help all students achieve at or above the Proficient Level and receive a C or better in the course. Performance level is determined by the average of the assessments or assignments.

	Not Proficient	Partial Proficient	Proficient	Advanced Proficient
Graded Student Work	**Rubric Avg. of 1 or less than 60%**	**Rubric Avg. of 2 or 60% - 69%**	**Rubric Avg. of 3 or 70% - 84%**	**Rubric Avg. of 4 or 85% - 100%**
Labs, Written Assignments, Perf. Tasks, and Projects	(6 pt rubric) **1-2** (4 pt rubric) **1**	(6 pt rubric) **3** (4 pt rubric) **2**	(6 pt rubric) **4** (4 pt rubric) **3**	(6 pt rubric) **5-6** (4 pt rubric) **4**
Teacher/Dept-developed Tests and Exams	**Less than 60%**	**60% - 69%**	**70% - 84%**	**85% - 100%**

SUGGESTED GRADE WEIGHTING:

(with some possible examples)

1. Assessment ~30%
- objective tests including comprehensive finals
- practica / performance tasks (rubric scored)
- constructed response questions (rubric scored)
- portfolios
- student self-evaluations

2. Homework not more than 10%
- discovery assignments
- assignments reinforcing class lesson
- essays
- organization
- research

3. Labs ~20%
- lab reports (may be rubric scored)
- active engagement in group work

4. Projects ~20%
- research-based written assignments and projects
- service learning projects
- inquiry projects
- science fair projects

5. Classwork ~20%
- note taking skills
- organization skills
- oral presentations
- graded individual and group work

STANDARD GRADING SCALE:

Advanced Proficient	A	90 – 100%
	B	80 – 89%
Proficient	C	70 – 79%
Partial Proficient	D	60 – 69%
Not Proficient	F	0 – 59%

Submitted by: Eric Brundin
School: Science Office
Date: 01/11
Revised Board Date: 2/15/11