

Earth Sciences -- Grades 9, 10, 11, and 12

California State Science Content Standards

Covered in:

**Hands-on science labs, demonstrations, & activities.
Investigation and Experimentation. Lesson Plans.**

Presented by Climate Change Education .org during

Mobile Climate Science Labs

- Professional development for teachers
 - In school presentations
- Climate science and hands-on education *specialists* presenting alongside teachers and teaching assistants
- Presentations at CSTA, NSTA, AAAS conferences
- For school field trips, as presented at local science museums

As aligned with existing science content standards, adopted 1997

Referencing: *Science Framework for California Public Schools*

<http://www.cde.ca.gov/ci/sc/cf/documents/scienceframework.pdf>

Adopted by the California State Board of Education

Published by the California Department of Education

Enabling teachers and schools to provide outstanding education called for in the standards under *Investigation and Experimentation* sections. Requirements for a minimum of 20-25% hands-on education in science.

Index of Standards Alignment—other grades, courses and standards:

http://climatechangeeducation.org/labs/k12_standards/index.html

Themes: <http://climatechangeeducation.org/labs/themes/index.html>

In the following, sections of standards noted are part of one or more lab theme.

Sections highlighted in **green** are a *primary focus* of one or more hands-on science lab.

Updated April 27, 2011

EARTH SCIENCES

Standard Set 1 Earth's Place in the Universe (Solar System)

1. Astronomy and planetary exploration reveal the solar system's structure, scale, and change over time. As a basis for understanding this concept:

1. a. *Students know 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. b. *Students know* 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. c. *Students know* the evidence from geological studies of Earth and other planets suggests that the early Earth was very different from Earth today.

1. d. *Students know* the evidence indicating that the planets are much closer to Earth than the stars are.

1. e. *Students know* the Sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium.

1. f. *Students know* 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. g.* *Students know* the evidence for the existence of planets orbiting other stars.

Standard Set 2 Earth's Place in the Universe (Stars, Galaxies and the Universe)

2. c. *Students know* the evidence indicating that all elements with an atomic number greater than that of lithium have been formed by nuclear fusion in stars.

2. d. *Students know 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.*

Standard Set 3 Dynamic Earth Processes

3. e. *Students know* 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. f.* *Students know* 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.

Standard Set 4 Energy in the Earth System (Solar Energy Enters, Heat Escapes)

4. **Energy enters the Earth system primarily as solar radiation and eventually escapes as heat. As a basis for understanding this concept:**
4. a. *Students know* **the relative amount of incoming solar energy compared with Earth's internal energy and the energy used by society.**
4. b. *Students know* **the fate of incoming solar radiation in terms of reflection, absorption, and photosynthesis.**
4. c. *Students know* **the different atmospheric gases that absorb the Earth's thermal radiation and the mechanism and significance of the greenhouse effect.**
4. d.* *Students know* **the differing greenhouse conditions on Earth, Mars, and Venus; the origins of those conditions; and the climatic consequences of each.**

Standard Set 5 Energy and the Earth System (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. As a basis for understanding this concept:

5. a. *Students know* **how differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.**
5. b. *Students know* the relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers.
5. c. *Students know* the origin and effects of temperature inversions.
5. d. *Students know* 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. e. *Students know* rain forests and deserts on Earth are distributed in bands at specific latitudes.
5. f.* *Students know* the interaction of wind patterns, ocean currents, and mountain ranges results in the global pattern of latitudinal bands of rain forests and deserts.

5. g.* *Students know* 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.

Standard Set 6 Energy in the Earth System (Climate and Weather)

6. Climate is the long-term average of a region's weather and depends on many factors. As a basis for understanding this concept:

6. a. *Students know* **weather (in the short run) and climate (in the long run) involve the transfer of energy into and out of the atmosphere.**

6. b. *Students know* **the effects on climate of latitude, elevation, topography, and proximity to large bodies of water and cold or warm ocean currents.**

6. c. *Students know* **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. d.* *Students know* **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.**

Standard Set 7 Biogeochemical cycles

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. As a basis for understanding this concept:

7. a. *Students know* **the carbon cycle of photosynthesis and respiration and the nitrogen cycle.**

7. b. *Students know* 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. c. *Students know* **the movement of matter among reservoirs is driven by Earth's internal and external sources of energy.**

7. d.* *Students know* **the relative residence times and flow characteristics of carbon in and out of its different reservoirs.**

Standard Set 8 Structure and Composition of the Atmosphere

8. Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life. As a basis for understanding this concept:

8. a. *Students know* **the thermal structure and chemical composition of the atmosphere.**

8. b. *Students know* **how the composition of the 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. c. *Students know* 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.

Standard Set 8 California Geology

9. c. *Students know* the **importance of water to society, the origins of California's fresh water, and the relationship between supply and need.**