

# Physics -- Grades 9, 10, 11, and 12

## California State Science Content Standards

Covered in:  
**Hands-on science labs, demonstrations, & activities.**  
**Investigation and Experimentation.**

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](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.

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# PHYSICS

## Standard Set 1 Motion and Forces

## Standard Set 2 Conservation of Energy and Momentum

### Standard Set 3 Heat and Thermodynamics

**3. b.** *Students know* that the work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature (first law of thermodynamics) and that this is an example of the law of conservation of energy.

**3. c.** *Students know* **the internal energy of an object includes the energy of random motion of the object's atoms and molecules, often referred to as *thermal energy*. The greater the temperature of the object, the greater the energy of motion of the atoms and molecules that make up the object.**

**3. d.** *Students know* that most processes tend to decrease the order of a system over time and that energy levels are eventually distributed uniformly.

**3. g.\*** *Students know* how to solve problems involving heat flow, work, and efficiency in a heat engine and know that all real engines lose some heat to their surroundings.

### Standard Set 4 Waves

**4. Waves have characteristic properties that do not depend on the type of wave. As a basis for understanding this concept:**

**4 a.** *Students know* **waves carry energy from one place to another.**

**4. c.** *Students know* **how to solve problems involving wavelength, frequency, and wave speed.**

**4. e.** *Students know* **radio waves, light, and X-rays are different wavelength bands in the spectrum of electromagnetic waves whose speed in a vacuum is approximately  $3 \times 10^8$  m/s (186,000 miles/second).**

### Standard Set 5 Electric and Magnetic Phenomena

**5. Electric and magnetic phenomena are related and have many practical applications. As a basis for understanding this concept:**

**5. a.** *Students know* how to predict the voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors, and capacitors.

**5. b.** *Students know* how to solve problems involving Ohm's law.

**5. c.** *Students know* any resistive element in a DC circuit dissipates energy, which heats the resistor. Students can calculate the power (rate of energy dissipation) in any resistive circuit element by using the formula  $\text{Power} = IR$  (potential difference)  $\times I$  (current)  $= I^2R$ .

**5. d.** *Students know* the properties of transistors and the role of transistors in electric circuits.

**5. f.** *Students know* magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.

**5. h.** *Students know* changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.