

# Standards

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This unit was developed to meet the following standards.

## California Academic Content Standards for Science, Grades 9–12

### Physics

#### Motion and Forces

1. Newton's laws predict the motion of most objects. As a basis for understanding this concept:
  - a. Students know how to solve problems that involve constant speed and average speed.
  - b. Students know that when forces are balanced, no acceleration occurs; thus, an object continues to move at a constant speed or stays at rest (Newton's first law).
  - c. Students know how to apply the law  $F = ma$  to solve one-dimensional motion problems that involve constant forces (Newton's second law).
  - d. Students know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law).
  - e. Students know the relationship between the universal law of gravitation and the effect of gravity on an object at the surface of Earth.
  - f. Students know applying a force to an object perpendicular to the direction of its motion causes the object to change direction but not speed (e.g., Earth's gravitational force causes a satellite in a circular orbit to change direction but not speed).
  - g. Students know circular motion requires the application of a constant force directed toward the center of the circle.
  - h. Students know how to solve problems involving the forces between two electric charges at a distance (Coulomb's law) or the forces between two masses at a distance (universal gravitation).

#### Conservation of Energy and Momentum

2. The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects. As a basis for understanding this concept:
  - a. Students know how to calculate kinetic energy by using the formula  $E = (1/2)mv^2$ .
  - b. Students know how to calculate changes in gravitational potential energy near Earth by using the formula (change in potential energy) =  $mgh$  ( $h$  is the change in the elevation).
  - c. Students know how to solve problems involving conservation of energy in simple systems, such as falling objects.

- d. Students know how to calculate momentum as the product  $mv$ .
- e. Students know momentum is a separately conserved quantity different from energy.
- f. Students know an unbalanced force on an object produces a change in its momentum.
- g. Students know how to solve problems involving elastic and inelastic collisions in one dimension by using the principles of conservation of momentum and energy.

### Investigation and Experimentation

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 four other strands, students should develop their own questions and perform investigations. Students will:
  - c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
  - d. Formulate explanations by using logic and evidence.

## Career and Technical Education (CTE) AME Industry Sector Foundation Standards

### 1.2 Science

*Specific applications of Investigation and Experimentation standards (Grades 9–12):*

- (1.c) Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
- (1.d) Formulate explanations by using logic and evidence.

## CTE AME Industry Sector Media and Design Arts Pathway Standards

### A.1.0 Visual and performing arts (VPA) and English-language arts (ELA)

Students master appropriate visual and performing arts (VPA) and English-language arts (ELA) content standards in relation to visual, aural, written, and electronic media projects and products.

### A1.7 ELA Written and Oral English Language Conventions

- (1.1) Demonstrate control of grammar, diction, and paragraph and sentence structure and an understanding of English usage.
- (1.2) Produce legible work that shows accurate spelling and correct punctuation and capitalization.