

CALIFORNIA SCIENCE CONTENT STANDARDS for
Biodefense: Detection to Protect the Nation

This lecture supports the California Content Standards* for Grades 9-12, as described online:
<http://www.cde.ca.gov/be/st/ss/scmain.asp>

PHYSICS

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:
 - c. *Students know* how to solve problems involving conservation of energy in simple systems, such as falling objects
 - h. Students know how to solve problems involving conservation of energy in simple systems with various sources of potential energy, such as capacitors and springs.

Heat and Thermodynamics

3. Energy cannot be created or destroyed, although in many processes energy is transferred to the environment as heat. As a basis for understanding this concept:
 - a. Students know heat flow and work are two forms of energy transfer between systems.

Waves

4. Waves have characteristic properties that do not depend on the type of wave. As a basis for understanding this concept:
 - a. Students know waves carry energy from one place to another.
 - c. Students know how to solve problems involving wavelength, frequency, and wave speed.
 - 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 3×10^8 m/s (or 186,000 miles/second).
 - f. Students know how to identify the characteristic properties of waves: interference (beats), diffraction, refraction, Doppler effect, and polarization.

CHEMISTRY

Atomic and Molecular Structure

1. The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure. As a basis for understanding this concept:
 - j. Students know that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's relationship ($E = hv$).

Chemical Bonds

2. Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules. As a basis for understanding this concept:
 - a. Students know atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.
 - b. Students know chemical bonds between atoms in molecules such as H_2 , CH_4 , NH_3 , H_2 , CCH_2 , N_2 , Cl_2 , and many large biological molecules are covalent.

Organic Chemistry and Biochemistry

10. The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life. As a basis for understanding this concept:
 - a. Students know large molecules (polymers), such as proteins, nucleic acids, and starch, are formed by repetitive combinations of simple subunits.

BIOLOGY/LIFE SCIENCES

Cell Biology

1. The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept:
 - a. Students know cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.
 - b. Students know enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings.
 - c. Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.
 - h. Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.

Physiology

10. Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response:
 - a. Students know the role of the skin in providing nonspecific defenses against infection.
 - b. Students know the role of antibodies in the body's response to infection.
 - c. Students know how vaccination protects an individual from infectious diseases.
 - d. Students know there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.
 - e. Students know why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.
 - f. *Students know the roles of phagocytes, B-lymphocytes, and T-lymphocytes in the immune system.

INVESTIGATION & 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 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.
 - d. Formulate explanations by using logic and evidence.
 - e. Recognize the cumulative nature of scientific evidence.
 - l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
 - 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.