

## INFORMATION MEMORANDUM

**DATE:** December 10, 2003

**TO:** MEMBERS, STATE BOARD OF EDUCATION

**FROM:** Geno Flores, Deputy Superintendent,  
Assessment and Accountability Branch

**SUBJECT:** Blueprints for the Middle School and High School Science Tests

The *No Child Left Behind Act of 2001* requires that, beginning in 2007-08 school year, each State administer three standards-based science tests every year, one within each of the following grade spans: 3-5, 6-9, and 10-12. These tests will be designed as core knowledge assessments, measuring the science concepts and skills that students should know and be able to do.

Educational Testing Service (ETS) field-tested a grade-5 science test in spring 2003 and will implement grade-5 science operational testing in spring 2004. This will meet the NCLB requirement to administer a test in the 3-5 grade span. To fully comply with NCLB requirements, tests must also be developed and administered in the 6-9 and 10-12 grade spans.

Recently, the Content Review Panel (CRP) met to select the specific grades within grade spans 6-9 and 10-12 in which to administer the tests and the standards to be assessed on each test.

The CRP recommends administering the test for grade span 6-9 in grade 8 assessing the 46 grade 8 physical science standards.

For the high school test, the CRP did not reach consensus regarding the specific grade at which to administer the high school science test though they narrowed it down to grade 10 or grade 11. They did, however, select 30 high school biology standards and 23 middle school life science standards to be assessed on the high school test.

[Attachment 1: High School Life Science Blueprint \(6 Pages\)](#)

[Attachment 2: Eighth Grade Blueprint \(4 Pages\)](#)

**HIGH SCHOOL LIFE SCIENCE**

<b>CELL BIOLOGY</b>		<b># Items</b>	<b>%</b>
		<b>10</b>	<b>17%</b>
<b>CALIFORNIA CONTENT STANDARDS: Grade 7</b>			
<b>1. All living organisms are composed of cells, from just one to many trillions, whose details usually are visible only through a microscope. As a basis for understanding this concept:</b>			
c. Students <i>know</i> the nucleus is the repository for genetic information in plant and animal cells.	✓		
d. Students <i>know</i> that mitochondria liberate energy for the work that cells do and that chloroplasts capture sunlight energy for photosynthesis.	✓		
e. Students <i>know</i> cells divide to increase their numbers through a process of mitosis, which results in two daughter cells with identical sets of chromosomes.	✓		
<b>CALIFORNIA CONTENT STANDARDS: Grade 8</b>			
<b>6. Principles of chemistry underlie the functioning of biological systems. As a basis for understanding this concept:</b>			
b. Students <i>know</i> that living organisms are made of molecules consisting largely of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.	✓		
c. Students <i>know</i> that living organisms have many different kinds of molecules, including small ones, such as water and salt, and very large ones, such as carbohydrates, fats, proteins, and DNA.	✓		
<b>CALIFORNIA CONTENT STANDARDS: Biology</b>			
<b>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:</b>			
a. Students <i>know</i> cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.	✓		
c. Students <i>know</i> how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.	✓		
f. Students <i>know</i> usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.	✓		

GENETICS	# Items	%
	12	20%
<b>CALIFORNIA CONTENT STANDARDS: Grade 7</b>		
<b>2. A typical cell of any organism contains genetic instructions that specify its traits. Those traits may be modified by environmental influences. As a basis for understanding this concept:</b>		
a. Students <i>know</i> the differences between the life cycles and reproduction methods of sexual and asexual organisms.	✓	
c. Students <i>know</i> an inherited trait can be determined by one or more genes.	✓	
d. Students <i>know</i> plant and animal cells contain many thousands of different genes and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive.	✓	
e. Students <i>know</i> DNA (deoxyribonucleic acid) is the genetic material of living organisms and is located in the chromosomes of each cell.	✓	
<b>CALIFORNIA CONTENT STANDARDS: Biology</b>		
<b>2. Mutation and sexual reproduction lead to genetic variation in a population. As a basis for understanding this concept:</b>		
b. Students <i>know</i> only certain cells in a multicellular organism undergo meiosis.	✓	
d. Students <i>know</i> new combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization).	✓	
e. Students <i>know</i> why approximately half of an individual's DNA sequence comes from each parent.	✓	
f. Students <i>know</i> the role of chromosomes in determining an individual's sex.	✓	
<b>3. A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization. As a basis for understanding this concept:</b>		
a. Students <i>know</i> how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and mode of inheritance (autosomal or X-linked, dominant or recessive).	✓	
<b>5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept:</b>		
a. Students <i>know</i> the general structures and functions of DNA, RNA, and protein.	✓	

PHYSIOLOGY	# Items	%
	10	17%
<b>CALIFORNIA CONTENT STANDARDS: Grade 7</b>		
<b>5. The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. As a basis for understanding this concept:</b>		
a. Students <i>know</i> plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.	✓	
c. Students <i>know</i> how bones and muscles work together to provide a structural framework for movement.	✓	
<b>6. Physical principles underlie biological structures and functions. As a basis for understanding this concept:</b>		
j. Students <i>know</i> that contractions of the heart generate blood pressure and that heart valves prevent backflow of blood in the circulatory system.	✓	
<b>CALIFORNIA CONTENT STANDARDS: Biology</b>		
<b>9. As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment. As a basis for understanding this concept:</b>		
a. Students <i>know</i> how the complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.	✓	
b. Students <i>know</i> how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.	✓	
<b>10. Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response:</b>		
b. Students <i>know</i> the role of antibodies in the body's response to infection.	✓	
c. Students <i>know</i> how vaccination protects an individual from infectious diseases.	✓	
d. Students <i>know</i> 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.	✓	

ECOLOGY	# Items	%
	11	18%
<b>CALIFORNIA CONTENT STANDARDS: Grade 6</b>		
<b>5. Organisms in ecosystems exchange energy and nutrients among themselves and with the environment. As a basis for understanding this concept:</b>		
b. Students <i>know</i> matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.	✓	
c. Students <i>know</i> populations of organisms can be categorized by the functions they serve in an ecosystem.	✓	
e. Students <i>know</i> the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.	✓	
<b>CALIFORNIA CONTENT STANDARDS: Biology</b>		
<b>6. Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:</b>		
a. Students <i>know</i> biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.	✓	
b. Students <i>know</i> how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.	✓	
c. Students <i>know</i> how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.	✓	
d. Students <i>know</i> how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.	✓	
e. Students <i>know</i> a vital part of an ecosystem is the stability of its producers and decomposers.	✓	
f. Students <i>know</i> at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid.	✓	

EVOLUTION	# Items	%
	11	18%
<b>CALIFORNIA CONTENT STANDARDS: Grade 7</b>		
<b>3. Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept:</b>		
a. Students <i>know</i> both genetic variation and environmental factors are causes of evolution and diversity of organisms.	✓	
b. Students <i>know</i> the reasoning used by Charles Darwin in reaching his conclusion that natural selection is the mechanism of evolution.	✓	
c. Students <i>know</i> how independent lines of evidence from geology, fossils, and comparative anatomy provide the bases for the theory of evolution.	✓	
<b>CALIFORNIA CONTENT STANDARDS: Biology</b>		
<b>7. The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept:</b>		
a. Students <i>know</i> why natural selection acts on the phenotype rather than the genotype of an organism.	✓	
b. Students <i>know</i> why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.	✓	
c. Students <i>know</i> new mutations are constantly being generated in a gene pool.	✓	
d. Students <i>know</i> variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.	✓	
<b>8. Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept:</b>		
a. Students <i>know</i> how natural selection determines the differential survival of groups of organisms.	✓	
b. Students <i>know</i> a great diversity of species increases the chance that at least some organisms survive major changes in the environment.	✓	
e. Students <i>know</i> how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.	✓	

INVESTIGATION AND EXPERIMENTATION	# Items	%
	6	10%
<b>CALIFORNIA CONTENT STANDARDS: Grade 6</b>		
<b>7. 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 three strands, students should develop their own questions and perform investigations. Students will:</b>		
c. Construct appropriate graphs from data and develop qualitative statements about the relationships between variables.		
e. Recognize whether evidence is consistent with a proposed explanation.		
<b>CALIFORNIA CONTENT STANDARDS: Grade 7</b>		
<b>7. 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 three strands, students should develop their own questions and perform investigations. Students will:</b>		
c. Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.		
<b>CALIFORNIA CONTENT STANDARDS: Grade 8</b>		
<b>9. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in other three strands, students should develop their own questions and perform investigations. Students will:</b>		
b. Evaluate the accuracy and reproducibility of data.		
c. Distinguish between variable and controlled parameters in a test.		
<b>CALIFORNIA CONTENT STANDARDS: Grades 9-12</b>		
<b>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:</b>		
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.		
f. Distinguish between hypothesis and theory as scientific terms.		
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).		
j. Recognize the issues of statistical variability and the need for controlled tests.		
<b>Total</b>	<b>60</b>	<b>100%</b>

## EIGHTH GRADE

CALIFORNIA CONTENT STANDARDS: Eighth Grade		
Focus on Physical Science	# Items	%
<b>Motion</b>	<b>8</b>	<b>13%</b>
<b>1. The velocity of an object is the rate of change of its position. As a basis for understanding this concept:</b>		
a. Students <i>know</i> position is defined in relation to some choice of a standard reference point and a set of reference directions.	✓	
b. Students <i>know</i> that average speed is the total distance traveled divided by the total time elapsed and that the speed of an object along the path traveled can vary.	✓	
c. Students <i>know</i> how to solve problems involving distance, time, and average speed.	✓	
d. Students <i>know</i> the velocity of an object must be described by specifying both the direction and the speed of the object.	✓	
e. Students <i>know</i> changes in velocity may be due to changes in speed, direction, or both.	✓	
f. Students <i>know</i> how to interpret graphs of position versus time and graphs of speed versus time for motion in a single direction.	✓	
<b>Forces</b>	<b>8</b>	<b>13%</b>
<b>2. Unbalanced forces cause changes in velocity. As a basis for understanding this concept:</b>		
a. Students <i>know</i> a force has both direction and magnitude.	✓	
b. Students <i>know</i> when an object is subject to two or more forces at once, the result is the cumulative effect of all the forces.	✓	
c. Students <i>know</i> when the forces on an object are balanced, the motion of the object does not change.	✓	
d. Students <i>know</i> how to identify separately the two or more forces that are acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction.	✓	
e. Students <i>know</i> that when the forces on an object are unbalanced, the object will change its velocity (that is, it will speed up, slow down, or change direction).	✓	
f. Students <i>know</i> the greater the mass of an object, the more force is needed to achieve the same rate of change in motion.	✓	
g. Students <i>know</i> the role of gravity in forming and maintaining the shapes of planets, stars, and the solar system.	✓	

CALIFORNIA CONTENT STANDARDS: Eighth Grade	# Items	%
<b>Structure of Matter</b>	<b>9</b>	<b>15%</b>
<b>3. Each of the more than 100 elements of matter has distinct properties and a distinct atomic structure. All forms of matter are composed of one or more of the elements. As a basis for understanding this concept:</b>		
a. Students <i>know</i> the structure of the atom and know it is composed of protons, neutrons, and electrons.	✓	
b. Students <i>know</i> that compounds are formed by combining two or more different elements and that compounds have properties that are different from their constituent elements.	✓	
c. Students <i>know</i> atoms and molecules form solids by building up repeating patterns, such as the crystal structure of NaCl or long-chain polymers.	✓	
d. Students <i>know</i> the states of matter (solid, liquid, gas) depend on molecular motion.	✓	
e. Students <i>know</i> that in solids the atoms are closely locked in position and can only vibrate; in liquids the atoms and molecules are more loosely connected and can collide with and move past one another; and in gases the atoms and molecules are free to move independently, colliding frequently.	✓	
f. Students <i>know</i> how to use the periodic table to identify elements in simple compounds.	✓	
<b>Earth in the Solar System (Earth Science)</b>	<b>7</b>	<b>12%</b>
<b>4. The structure and composition of the universe can be learned from studying stars and galaxies and their evolution. As a basis for understanding this concept:</b>		
a. Students <i>know</i> galaxies are clusters of billions of stars and may have different shapes.	✓	
b. Students <i>know</i> that the Sun is one of many stars in the Milky Way galaxy and that stars may differ in size, temperature, and color.	✓	
c. Students <i>know</i> how to use astronomical units and light years as measures of distances between the Sun, stars, and Earth.	✓	
d. Students <i>know</i> that stars are the source of light for all bright objects in outer space and that the Moon and planets shine by reflected sunlight, not by their own light.	✓	
e. Students <i>know</i> the appearance, general composition, relative position and size, and motion of objects in the solar system, including planets, planetary satellites, comets, and asteroids.	✓	

CALIFORNIA CONTENT STANDARDS: Eighth Grade	# Items	%
<b>Reactions</b>	<b>7</b>	<b>12%</b>
<b>5. Chemical reactions are processes in which atoms are rearranged into different combinations of molecules. As a basis for understanding this concept:</b>		
a. Students <i>know</i> reactant atoms and molecules interact to form products with different chemical properties.	✓	
b. Students <i>know</i> the idea of atoms explains the conservation of matter: In chemical reactions the number of atoms stays the same no matter how they are arranged, so their total mass stays the same.	✓	
c. Students <i>know</i> chemical reactions usually liberate heat or absorb heat.	✓	
d. Students <i>know</i> physical processes include freezing and boiling, in which a material changes form with no chemical reaction.	✓	
e. Students <i>know</i> how to determine whether a solution is acidic, basic, or neutral.	✓	
<b>Chemistry of Living Systems (Life Science)</b>	<b>3</b>	<b>5%</b>
<b>6. Principles of chemistry underlie the functioning of biological systems. As a basis for understanding this concept:</b>		
a. Students <i>know</i> that carbon, because of its ability to combine in many ways with itself and other elements, has a central role in the chemistry of living organisms.	✓	
b. Students <i>know</i> that living organisms are made of molecules consisting largely of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.	✓	
c. Students <i>know</i> that living organisms have many different kinds of molecules, including small ones, such as water and salt, and very large ones, such as carbohydrates, fats, proteins, and DNA.	✓	
<b>Periodic Table</b>	<b>7</b>	<b>12%</b>
<b>7. The organization of the periodic table is based on the properties of the elements and reflects the structure of atoms. As a basis for understanding this concept:</b>		
a. Students <i>know</i> how to identify regions corresponding to metals, nonmetals, and inert gases.	✓	
b. Students <i>know</i> each element has a specific number of protons in the nucleus (the atomic number) and each isotope of the element has a different but specific number of neutrons in the nucleus.	✓	
c. Students <i>know</i> substances can be classified by their properties, including their melting temperature, density, hardness, and thermal and electrical conductivity.	✓	

<b>CALIFORNIA CONTENT STANDARDS: Eighth Grade</b>	<b># Items</b>	<b>%</b>
<b>Density and Buoyancy</b>	<b>5</b>	<b>8%</b>
<b>8. All objects experience a buoyant force when immersed in a fluid. As a basis for understanding this concept:</b>		
a. Students <i>know</i> density is mass per unit volume.	✓	
b. Students <i>know</i> how to calculate the density of substances (regular and irregular solids and liquids) from measurements of mass and volume.	✓	
c. Students <i>know</i> the buoyant force on an object in a fluid is an upward force equal to the weight of the fluid the object has displaced.	✓	
d. Students <i>know</i> how to predict whether an object will float or sink.	✓	
<b>Investigation and Experimentation</b>	<b>6</b>	<b>10%</b>
<b>9. 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 three strands, students should develop their own questions and perform investigations. Students will:</b>		
a. Plan and conduct a scientific investigation to test a hypothesis.		
b. Evaluate the accuracy and reproducibility of data.		
c. Distinguish between variable and controlled parameters in a test.		
d. Recognize the slope of the linear graph as the constant in the relationship $y = kx$ and apply this principle in interpreting graphs constructed from data.		
e. Construct appropriate graphs from data and develop quantitative statements about the relationships between variables.		
f. Apply simple mathematic relationships to determine a missing quantity in a mathematic expression, given the two remaining terms (including speed = distance/time, density = mass/volume, force = pressure x area, volume = area x height).		
g. Distinguish between linear and nonlinear relationships on a graph of data.		
<b>Total</b>	<b>60</b>	<b>100%</b>