OFFICE OF CURRICULUM, INSTRUCTION, & PROFESSIONAL DEVELOPMENT

HIGH SCHOOL COURSE OUTLINE

(Revised January 2011)

Department	Science	**Course Title**	Biology 1-2	**Course Code**	3801				
Grade Level	9-12	**Short Title**	BIOLOGY 1-2	**Grad Requirement**	Yes				
Course Length	semesters	Credits per Semester	5	Approved for Honors	No	Required		Elective	X
Prerequisites	Algebra 1-2 or CD (can be concurrently enrolled), or science teacher recommendation								
Co-requisites	None								
Articulated with LBCC	No	Articulated with CSULB	No						
Meets UC "a-g" Requirement	Yes (d)	Meets NCAA Requirement	Yes						

COURSE DESCRIPTION:

This course is a standards-based study of living things: origins, structures, functions, heredity, growth and development, interactions among, and behavior of living things. Content is built around major biological concepts such as biochemistry and the biology of cells, genetics, evolution, ecology, physiologic systems, and the diversity of living things. Emphasis is placed on the utilization of mathematical, analytical, data acquisition, and communication skills as well as interdisciplinary approaches to discovery. Concepts and skills are reinforced by a strong emphasis on hands-on laboratory experiences, integration of other branches of science, and applications to society and individuals. Utilization of technology is included, as is consideration of the impact of human activity on biological systems. Biology fulfills both the life science high school graduation requirement and the UC/CSU "d" laboratory science requirement. A course in the physical sciences is also needed to complete the minimum graduation requirement for high school.

COURSE PURPOSE: GOALS (Student needs the course is intended to meet)

CONTENT
- Students will learn all of the required California State Standards for Biology/Life Sciences. They will explore the basic building blocks of life, investigating cellular structures, their functions, and the interactions of macromolecules. They will learn of the genetic implications of DNA and the processes by which it regulates cells, organisms, and populations. Students will investigate techniques used by scientists to manipulate DNA, and for what purposes. They will consider the larger contexts of ecology and evolution, but will also focus on introductory details of human physiology and immunology.

SKILLS
- Students will apply measurement, observation, statistical, and technological skills while investigating biological and ecological concepts. Evidence and experimental data will be analyzed for reliability and possible sources of error. The use of well-designed, memorable laboratory and field experiences will facilitate this application of scientific knowledge and methodology and is essential in helping students to analyze the content critically. Students will learn how ethical considerations play an important role in modern biological fields and explore the importance of personal accountability in both individual and group work situations.

LITERACY
- Students will improve their ability to learn independently by researching and drawing generalizations from science related articles, books, graphs, charts, and diagrams. They will also learn the common scientific roots the make vocabulary in the biological context more accessible. Regular opportunities are provided for students to clearly communicate their understanding through oral and written explanations of science concepts.

APPLICATIONS
- Students will study the applications of biology to ecological, medical, commercial, and ethical issues to develop critical thinking skills, as they apply to decision making in both societal and personal contexts. They will explore both the education and self-promotion skills needed for these professions. This will inspire students to consider pursuing advanced studies in science and the wide variety of related career choices.

COURSE PURPOSE: EXPECTED OUTCOMES

Students are expected to perform at a proficient level on a variety of tasks and assessments addressing both the content and skill standards for Biology/Life Sciences. Levels of proficiency are defined near the end of this course outline under Performance Standards.

Grade 9-12 Biology/Life Sciences:
from the Science Standards for California Public Schools, adopted by the California State Board of Education in October, 1998.

Cell Biology: ..... (15.0% of CST)

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.

Genetics ..... (31.6% of CST)

2. Meiosis and Fertilization - Mutation and sexual reproduction lead to genetic variation in a population.
3. Mendel's Laws - A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization.
4. Molecular Biology - Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism.
5. Biotechnology - The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells.

Ecology ..... (11.7% of CST)

6. Stability in an ecosystem is a balance between competing effects.

Evolution ..... (15.0% of CST)

7. Population Genetics - The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time.
8. Speciation - Evolution is the result of genetic changes that occur in constantly changing environments.

Physiology ..... (16.7% of CST)

9. Homeostasis - 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.
10. Infection and Immunity - Organisms have a variety of mechanisms to combat disease.

Investigation and Experimentation ..... (10.0% of CST)

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. (CST)
   b. identify and communicate sources of unavoidable experimental error. (CST)
   c. identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions. (CST)
   d. formulate explanations by using logic and evidence. (CST)
   e. distinguish between hypothesis and theory as scientific terms. (CST)
   f. recognize the usefulness and limitations of models and theories as scientific representations of reality. (CST)
   g. read and interpret topographic and geologic maps. (CST)
   h. 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). (CST)
   i. recognize the issues of statistical variability and the need for controlled tests. (CST)
   j. recognize the cumulative nature of scientific evidence. (CST)
   k. analyze situations and solve problems that require combining and applying concepts from more than one area of science. (CST)
   l. 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. (CST)
   m. know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e. g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets). (CST)

CST = Standards assessed on the California Standards Test

COURSE PURPOSE: EXPECTED INTEGRATED OUTCOMES

Students are also expected to proficiently apply common skills that are relevant across curriculum areas and career pathways. The following are those skills most applicable to this science course.

CTE Foundation Standards:

from the California Career Technical Education Model Curriculum Standards, adopted by the California State Board of Education in May, 2005.

Foundation Standard 2: Communications

Students understand the principles of effective oral, written and multimedia communication in a variety of formats and contexts.

Reading (Grades 9-10)

- 1.3 Identify Greek, Roman, and Norse mythology and use the knowledge to understand the origin and meaning of new words.
- 2.2 Prepare a bibliography of reference materials for a report using a variety of consumer, workplace, and public documents.
- 2.3 Generate relevant questions about readings on issues that can be researched.
- 2.8 Evaluate the credibility of an author's argument or defense of a claim by critiquing the relationship between generalizations and evidence, the comprehensiveness of evidence, and the way in which the author's intent affects the structure and tone of the text (e.g., in professional journals, editorials, political speeches).

Writing (Grades 9-10)

- 1.3 Use clear research questions and suitable research methods (e.g., library, electronic media, personal interview) to elicit and present evidence from primary and secondary sources.
- 1.5 Synthesize information from multiple sources and identify complexities and discrepancies in the information and the different perspectives found in each medium (e.g., almanacs, microfiche, news sources, in-depth field studies, speeches, journals, technical documents).
- 2.3 Write expository compositions, including analytical essays and research reports:
  - 2.3.a Marshal evidence in support of a thesis and related claims, including information on all relevant perspectives.
  - 2.3.b Convey information and ideas from primary and secondary sources accurately and coherently.
  - 2.3.c Make distinctions between the relative value and significance of specific data, facts, and ideas.
  - 2.3.d Include visual aids by employing appropriate technology to organize and record information on charts, maps, and graphs.
  - 2.3.e Anticipate and address readers' potential misunderstanding, biases, and expectations.
  - 2.3.f Use technical terms and notations accurately.
- 2.6 Write technical documents:
  - 2.6.a Report information and convey ideas logically and correctly.
  - 2.6.b Offer detailed and accurate specifications.
  - 2.6.c Include scenarios, definitions, and examples to aid comprehension (e.g., troubleshooting guide).
  - 2.6.d Anticipate reader's problems, mistakes, and misunderstandings.

Written and Oral English Language Conventions (Grades 9-10)

- 1.4 Produce legible work that shows accurate spelling and correct use of the conventions of punctuation and capitalization.

Listening and Speaking (Grades 9-10)

- 1.7 Use props, visual aids, graphs, and electronic media to enhance the appeal and accuracy of presentations.
- 2.3 Apply appropriate interviewing techniques:
  - 2.3.a Prepare and ask relevant questions.
  - 2.3.b Make notes of responses.
  - 2.3.c Use language that conveys maturity, sensitivity, and respect.
  - 2.3.d Respond correctly and effectively to questions.
  - 2.3.e Demonstrate knowledge of the subject or organization.
  - 2.3.f Compile and report responses.
  - 2.3.g Evaluate the effectiveness of the interview.
- 2.5 Deliver persuasive arguments (including evaluation and analysis of problems and solutions and causes and effects).
  - 2.5.a Structure ideas and arguments in a coherent, logical fashion.
  - 2.5.b Use rhetorical devices to support assertions (e.g., by appeal to logic through reasoning; by appeal to emotion or ethical belief; by use of personal anecdote, case study, or analogy).
  - 2.5.c Clarify and defend positions with precise and relevant evidence, including facts, expert opinions, quotations, expressions of commonly accepted beliefs, and logical reasoning.
  - 2.5.d Anticipate and address the listener's concerns and counterarguments.

Foundation Standard 3: Career Planning and Management

Students understand how to make effective decisions, use career information, and manage career plans.

3.5 Understand the past, present, and future trends that affect careers, such as technological developments and societal trends, and the resulting need for lifelong learning.

3.6 Know important strategies for self-promotion in the hiring process, such as job applications, resume writing, interviewing skills, and preparation of a portfolio. [*re: biotechnology careers, biology standard 5c*]

Foundation Standard 4: Technology

Students know how to use contemporary and emerging technological resources in diverse and changing personal, community, and workplace environments.

4.2 Understand the use of technological resources to gain access to, manipulate, and produce information, products, and services.

4.3 Understand the influence of current and emerging technology on selected segments of the economy.

Foundation Standard 5: Problem Solving and Critical Thinking

Students understand how to create alternative solutions by using critical and creative thinking skills, such as logical reasoning, analytical thinking, and problem solving techniques.

5.1 Apply appropriate problems-solving strategies and critical thinking skills to work-related issues and tasks.

5.3 Use critical thinking skills to make informed decisions and solve problems.

[*re: biotechnology, 5c,e; re: ecology, 6b,c,e; physiology 10c*]

Foundation Standard 6: Health and Safety

Students understand health and safety policies, procedures, regulations, and practices, including the use of equipment and handling of hazardous materials.

6.1 Know the policies, procedures, and regulations regarding health and safety in the workplace, including employers' and employees' responsibilities.

6.2 Understand critical elements of health and safety practices related to storing, cleaning, and maintaining tools, equipment, and supplies.

Foundation Standard 7: Responsibility and Flexibility

Students know the behaviors associated with the demonstration of responsibility and flexibility in personal, workplace, and community settings.

7.1 Understand the qualities and behaviors that constitute a positive and professional work demeanor.

7.2 Understand the importance of accountability and responsibility in fulfilling personal, community, and workplace roles. [*re: biotechnology, 5c; ecology, 6b; physiology 10e*]

7.3 Understand the need to adapt to varied roles and responsibilities.

7.4 Understand that individual actions can affect the larger community.

Foundation Standard 8: Ethics and Legal Responsibilities

Students understand professional, ethical, and legal behavior consistent with applicable laws, regulations, and organizational norms.

8.2 Understand the concept and application of ethical and legal behavior consistent with workplace standards.

8.3 Understand the role of personal integrity and ethical behavior in the workplace. [*re: ecology, 6b*]

Foundation Standard 9: Leadership and Teamwork

Students understand effective leadership styles, key concepts of group dynamics, team and individual decision making, the benefits of workplace diversity, and conflict resolution.

9.1 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace setting.

9.2 Understand the ways in which pre professional associations and competitive career development activities enhance academic skills, promote career choices, and contribute to employability.

9.3 Understand how to organize and structure work individually and in teams for effective performance and the attainment of goals. [*re: cell biology, 1d; any group project, especially the Content Project with Service Learning – see p. 50*]

9.4 Understand how to interact with others in ways that demonstrate respect for individual and cultural differences and for the attitudes and feelings of others.

OUTLINE OF CONTENT AND SUGGESTED TIME ALLOTMENT:

The Task Analysis and Key Vocabulary presented here are drawn from the Science Framework for California Public Schools, which defines the intent and scope of the Science Content Standards. For additional information on the context and the benchmark standards to assess, refer to the Blueprints for the Biology Content Standards Test (CST) and the 10th Grade Life Sciences Test (LS10). Skill Standards designated **FS** refers to the Foundation Standards of the CA Career Technical Education Model Curriculum Standards [pages 3 and 4]. Content sequencing, Labs/Demos, and time allocations are only suggestions and may be adjusted to suit school site curriculum plans, available materials, and student needs.

Cell Biology ***15% CST***

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.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings. **(1,a)** [CST, LS10]	• Describe how phospholipids are organized to form a fluid mosaic cell membrane. • Describe the functions of proteins in the cell membrane. • Explain the difference between diffusion and osmosis. • Compare and contrast passive and active transport. ∗ *Explain how large particles get into and out of cells. (LBUSD)* ***Skills Focus:*** microscopy, influence, recognition, observation	***Key Assignments:*** • **Plasmolysis in Elodea Leaf or Red Onion Cells** [See description on p. 51.] • **Osmosis and Selective Permeability** [See description on p. 51.] • **Analogy Project** (possible) [See description on p. 50, top of Projects section.] ***Suggested:*** • **Wet-mount Slide Preparation: Comparing Eukaryote Plant and Animal Cells** Students prepare wet-mount of onion and elodea cell layer noting what different magnification will show and how the amount of water affects the depth of field and resolution. They then compare prepared animal cells to their wet-mount plant cells to note general and specific differences regarding shapes and structures. From these observations, students draw conclusions about how the structures they noted relate to the cell's function within the organism. OES: pending PT: pending	**CA Bio**, Ch 7:3 ***Supplemental Resources:*** • CA Bio, Lab Manual A, p. 85 "Observing Osmosis" • CA Bio, p. 187, Quick Lab., "How Can You Model Permeability in Cells?" • CA Bio, p. 194, Exploration, "Investigating Cell Structures and Processes" ***Key Vocabulary:*** semipermeable, membrane, fluid, hypotonic, concentration gradient, exocytosis, mosaic, diffusion, osmosis, hypertonic, isotonic, endocytosis	4 Days (2 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… enzymes are proteins and 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. **(1b)** [CST]	• Show that enzymes function as biological catalysts. They speed up spontaneous reactions by lowering the activation energy without being consumed. • Illustrate how protein shapes create the lock-and-key model of enzymes. ∗ *Illustrate the induced fit model of enzymes. (LBUSD)* ∗ *Show how H^+ and OH^- ions relate to the pH scale and where this is important in biological systems. (LBUSD)* • Demonstrate that the activity of enzymes depends upon temperature, ionic conditions, and pH of the surroundings. ***Skills Focus:*** model, analyze, compare, predict, observe Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** • **Enzyme Lab** [See description on p. 51.] ***Suggested:*** • CA Bio, Design an Exp., p. 54 "Investigation the Effect of Temp. on Enzyme Activity" OES: pending PT: pending	**CA Bio**, Ch 2:4 ***Supplemental Resources:*** • CA Bio, Quick Lab, p. 42 "Are Foods Acidic or Basic?" • **Observing Catalysis** Observe catalase from liver homogenate or yeast reacting with peroxide substrate. • **Reaction Rate Investigations** Have student groups choose different variables to investigate and share results with the rest of the class. ***Key Vocabulary:*** protein, enzyme, catalyst, activation energy, acid, active site, spontaneous, substrate, concentration, pH, base	2 Days (1 Block)
… how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure. **(1c)** [CST, LS10]	∗ *Describe five properties shared by all living organisms. (LBUSD)* • Explain why viruses cannot be considered as living organisms. • Distinguish prokaryotes and eukaryotes. • Describe how each organelle performs a task essential to the life of the cell. • Describe the composition of the nucleus. • Compare and contrast the structure of an animal cell with that of a plant cell. • State the three basic concepts included in the cell theory. ***Skills Focus:*** model, analyze, microscopy Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • **Cell City Activity** Students create an analogy of cell organelles to city operations. Or, students can create their own analogy of adequate complexity. OES: pending PT: pending	**CA Bio**, Ch 7:1-2 ***Supplemental Resources:*** ***Key Vocabulary:*** prokaryotes, eukaryotes, virus, ER, ribosome, cytoplasm, lysosome, organelle, vesicle, vacuole, genetic, DNA, RNA, GB, nucleus, cytoskeleton, mitochondrion, cell membrane, chloroplast, cell wall	4 Days (2 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the Central Dogma of molecular biology outlines the flow of information from transcription of ribonucleic acid (RNA) in the nucleus to translation of proteins on ribosomes in the cytoplasm. **(1d)** [CST]	*NOTE: The point of this standard is to become familiar with the overall flow of information from DNA codes to structural proteins. Do not get into the details of how this happens (base pairing, transcription and translation processes). These will be addressed later in Standard Sets 4 and 5.* • Describe the DNA in the nucleus as the template code from which proteins are made. • Explain that parts of the DNA contain codes for specific proteins. • Explain that when proteins are needed, their part of the DNA is copied (transcribed) into messenger RNA (mRNA). • Explain that mRNA carries the code to ribosomes out in the cytoplasm, where it is converted (translated) into the protein originally coded by the DNA. • Recall that this process is considered the Central Dogma of molecular biology. ***Skills Focus:*** model, analyze [re: student skit activity] Understand how to organize and structure work individually and in teams for effective performance and the attainment of goals. **(FS 9.3)**	***Key Assignments:*** - none - ***Suggested:*** • **Modeling Protein Synthesis** Have student groups design a brief skit or physical model that shows the processes of transcription and translation. OES: pending PT: pending	**CA Bio**, Ch 12:3 ***Supplemental Resources:*** ***Key Vocabulary:*** DNA RNA template	2 Days (1 Block)
… the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins. **(1e)** [CST]	• Identify two types of endoplasmic reticulum (ER): smooth and rough. ◦ Recall that rough ER synthesizes proteins. ◦ Recall that smooth ER modifies, or detoxifies lipids. • Explain that proteins that are to be sent outside the cell are moved to the Golgi apparatus where they are modified, packaged in vesicles, and moved to the cell membrane to be secreted. ***Skills Focus:*** model, analyze	***Key Assignments:*** - none - ***Suggested:*** • **Student-Generated Analogies** Have students create detailed analogies for the functions of the rough ER, smooth ER, and Golgi apparatus (i.e., the Golgi apparatus as a post office). OES: pending PT: pending	**CA Bio**, Ch 7:2 ***Supplemental Resources:*** ***Key Vocabulary:*** Rough ER Smooth ER Golgi apparatus	1 Day (½ Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time

… usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide. **(1f)**
[CST, LS10]
	• Explain that photosynthesis is a complex process that converts visible light energy into chemical energy in the bonds of carbohydrate molecules.
	• Recall that the processes of photosynthesis take place within chloroplasts, which can be seen under a microscope in plant cells and photosynthetic protists.
	• Explain that photosynthesis occurs in two reactions: one light-dependent and the other light-independent.
	  ° Diagram the light-dependent reaction within the thylakoid membrane where water is oxidized and light energy is first converted into chemical bond energy generating ATP, NADPH + H^+, and O_2.
	  ° Diagram the light-independent reaction (Calvin cycle) with the stroma where carbon dioxide, ATP, and NADPH + H^+ react to form phosphoglyceraldehyde, which is then converted into sugars.
	Skills Focus:
	model, analyze, microscopy, inference, computer modeling, measuring
	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. **(I&E 1.a)**
	Formulate explanations by using logic and evidence. **(I&E 1.d)**
		Key Assignments:
		• **Photosynthesis / Cellular Respiration** [See description on p. 51.]
		Suggested:
		• **Microscope Observations** Have students observe carefully prepared or commercially produced thin section slides. They should note structural organization and explain how it facilitates of the cells to sunlight and carbon dioxide during photosynthesis. CA Sci. Framework, p 223
		• **Photosynthesis Rate Investigations** Have students measure oxygen production rates of aquatic plants, such as elodea, by collecting the oxygen gas in a volumeter. Students should be encouraged to explore the effects of different variables on the rate of O_2 production. *[Note: if students want to vary the intensity of light by varying the distance to a light source, they can place a flat-sided bottle of water between the plant and the light source to dissipate unwanted heat that would affect the results.]* CA Sci. Framework, p 223
		• CA Bio, Design an Experiment, p. 215, "Investigating Photosynthesis"
		OES: pending
		PT: pending
			CA Bio, Ch 8:3, 23:4
			Supplemental Resources:
			• Lab Simulations CD-ROM, Photosynthesis
			• CA Bio, Quick Lab, p. 206, "What waste material is produced during photosynthesis?"
			• CA Bio, Lab Manual (A), p. 91, or (B) p. 87, "Measuring the Effect of Light Intensity on Photosynthesis"
			Key Vocabulary:
			ATP NADPH
			pigment chlorophyll
			thylakoids
				5 Days (3 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the role of the mitochondria in making stored chemical bond energy available to cells by completing the breakdown of glucose to carbon dioxide. **(1g)** [CST]	• Define cellular respiration as a series of reactions that release the chemical energy stored in the bonds of fat, protein, and carbohydrate (mostly glucose) molecules. ∗ *Diagram glycolysis, the first step of respiration, where 6-carbon glucose is broken down into two 3-carbon fragments (pyruvates) in the cytoplasm. (LBUSD)* • Diagram how the 3-carbon fragments (pyruvates) are broken down to CO_2 and H_2O in the matrix (cytoplasm) of mitochondria. • Diagram how ATP is produced through electron transport chain at the cristae (inner membrane). • Explain that most of the energy produced by respiration is put into the bonds of ATP, a molecule that powers most cell activities. ∗ *Diagram alternate reactions (lactic acid and alcohol fermentation) that occur in mitochondria in the absence of oxygen (anaerobic reactions). (LBUSD)* ***Skills Focus:*** model, interpreting	***Key Assignments:*** - none - ***Suggested:*** • **Modeling Molecular Interactions** Have groups of students act out the interactions of the carbon fragments and ADP/ATP within the mitochondria, or model with process with visuals. OES: pending PT: pending	**CA Bio**, Ch 9:1 ***Supplemental Resources:*** • CA Bio, Lab Manual (A), p. 95, or (B) p. 91, "Observing Respiration" ***Key Vocabulary:*** glycolysis, aerobic, anaerobic, $FADH_2$, FAD, Krebs Cycle, fermentation	4 Days (2 Blocks)
… most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors. **(1h)** [CST]	• Identify the common, macromolecules that are polymers (like a chain) of monomers (the links). ◦ Distinguish the monosaccharides within polysaccharides. ◦ Distinguish the amino acids in a protein. ◦ Distinguish the fatty acids, glycerol, and other components in lipids. ◦ Distinguish the nucleotides in nucleic acids. • Point out the carbon "backbone" of each of these macromolecules. ***Skills Focus:*** compare, contrast	***Key Assignments:*** • **Macromolecule Lab** [See description on p. 51.] ***Suggested:*** • **Macro-Molecular Mugshots** Students identify various representations (2-D and 3-D) of macromolecule monomers and polymers, identifying the characteristic components. • CA Bio, Lab Manual (A), p. 59, "Identifying Organic Compounds" • CA Bio, Lab Manual (B), p. 59, "Discovering Where Proteins are Found" OES: pending PT: pending	**CA Bio**, Ch 2:3 ***Supplemental Resources:*** ***Key Vocabulary:*** polymers, monomers, amino acids, nucleotides, DNA, RNA, glucose, starch, saturated, unsaturated, hydrogenated, phospholipids, steroids, waxes, monosaccharide, polysaccharide, glycerol, lipid, nucleic acids	2 Days (1 Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how chemiosmotic gradients in the mitochondria and chloroplast store energy for ATP production. **(1i*)**	∗ *Identify ATP synthase (called the ATP-producing carrier protein in the Bio:P&E text) as the protein responsible for producing most of the ATP in cells.* ∗ *Recall that these proteins are located within the thylakoid membrane of chloroplasts and the cristae membranes of mitochondria.* ∗ *Explain how the electron transport chain pumps protons (H^+) out of the thylakoid or cristae membranes.* ∗ *Explain that the energy released by the H^+ passing back inside through the ATP synthase pores is the energy used to ADP and P to form the energized ATP.* ***Skills Focus:*** diagram	***Key Assignments:*** - none - ***Suggested:*** • **Modeling Molecular Interactions** Have groups of students act out the interactions of aerobic respiration at the mitochondrial membrane showing how electrons and H^+ ions are moved, or the model process with visuals. OES: pending PT: pending	**CA Bio**, Ch 8:3, 9:2 ***Supplemental Resources:*** • CA Bio, 2 Instruct, p. 226 TE, "The Krebs Cycle" Demonstrate or have students perform this (blow into bromthymol blue solution) as an introduction to the topic. ***Key Vocabulary:*** ATP synthase cristae	2 Days (1 Block)
… how eukaryotic cells are given shape and internal organization by a cytoskeleton or cell wall or both. **(1j*)**	∗ *Describe the cytoskeleton as the more rigid structures within the cytoplasm that give shape and organization eukaryotic cells.* ∗ *Explain that the cytoskeleton is composed of fine protein threads (called microfilaments) and thin protein tubes (called microtubules).* ∗ *Depict the "9+2" arrangement (9 pairs of microtubules around 2 individual microtubules) which make up cilia and flagella.* ∗ *Explain how the rapid assembly and disassembly of microtubules and microfilaments, and their ability to slide past one another enable cells to move (for example, white blood cells and amoeba).* ∗ *Explain how movement of organelles within the cell use this same mechanism.* ***Skills Focus:*** model, microscopy, observe Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • **Observing Microtubules** Observe plant mitosis in onion root tips to see microtubules that make up the spindle apparatus. Prepared slides of white fish blastula show microtubules in animal cells as the spindle apparatus and centrioles. CA Sci. Framework, p 224 OES: pending PT: pending	**CA Bio**, Ch 7:2-3 ***Supplemental Resources:*** • **9+2 Microtubule Arrangement in Eukaryotic Flagella and Cilia** Electron microscopic cross-section, diagram, and explanation of how movement occurs. ***Key Vocabulary:*** microfilaments microtubules	2 Days (1 Block)

Genetics (Meiosis and Fertilization) ***11.7% CST***

2. Mutation and sexual reproduction lead to genetic variation in a population.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type. **(2a)** [CST]	∗ *Recall the steps of mitosis (which is taught in 7th grade).* • Recall that gametes have only one set of chromosomes (haploid), as opposed to other cells that have two sets of chromosomes (diploid). • Explain that producing haploid gametes involves two cell divisions. ° Diagram meiosis I, highlighting Prophase I in which the paired homologous chromosomes may exchange parts through breakage and reunion (crossing-over). ° Diagram meiosis II, showing the same mechanics as mitosis, except for skipping DNA replication, thereby ending up with the haploid number of chromosomes. ° Show from diagrams how the four cells formed by the two divisions of meiosis have different chromosomal components (segregation). • Recall that all four haploid cells formed by meiosis in a male produce sperm cells. • Recall that only one of the four haploid cells formed by meiosis in a female forms an egg, while the other three remain small, degenerate polar bodies that cannot be fertilized. ***Skills Focus:*** Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)**	***Key Assignments:*** • **Meiosis Models** Construct models (without merely copying a template) that illustrate the segregation that takes place during mitosis and meiosis. Suggest using colored yarn or pipe cleaners to represent chromosomes. CA Sci. Framework, p 225 [See full description on p. 51.] ***Suggested:*** OES: pending PT: pending	**CA Bio**, Ch 11:4 ***Supplemental Resources:*** • CA Bio, Exploration, p 281, "Modeling Meiosis" • **Meiosis Observations** Observe meiosis stages in prepared slides of Ascaris blastocyst cells. CA Sci. Framework, p 225 ***Key Vocabulary:*** meiosis (prophase, metaphase, anaphase, telophase, cytokinesis) haploid diploid polar bodies	4 Days (2 Blocks)
… only certain cells in a multicellular organism undergo meiosis. **(2b)** [CST, LS10]	• Recall that only specific diploid cells undergo meiosis. ° Recall that diploid spermatogonia cells in the testes of males produce haploid sperm. ° Recall that diploid oogonia cells in the ovaries of females produce haploid eggs. ***Skills Focus:*** recognize context	***Key Assignments:*** - none - ***Suggested:*** • **Meiosis Locus-Pocus** Determine the location (locus) of meiosis in various multicellular organisms (not just animals) that reproduce sexually. OES: pending PT: pending	**CA Bio**, Ch 11:4 ***Supplemental Resources:*** • **Meiosis** http://faculty.clintoncc.suny.edu/faculty/michael.gregory/files/bio%20101/bio%20101%20lectures/meiosis/meiosis.htm ***Key Vocabulary:*** spermatogonia oogonia	1 Day (½ Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how random chromosome segregation explains the probability that a particular allele will be in a gamete. **(2c)** [CST]	• Identify the steps in meiosis where random segregation of genetic information occurs leading to four distinct and genetically different gametes. • Explain how mere chance determines which chromosomes are pulled to a given side during karyokinesis (division of the nucleus). • Explain how this process allows predictions about genetic sorting to be made using laws of probability. ***Skills Focus:*** Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)**	***Key Assignments:*** - none - ***Suggested:*** • **Genetic Chart (Part I)** Create a chart marking traits on chromosomes alternately coming from either the mother of father. Then show how random segregation leads to some gametes carrying a given maternal trait, while others will carry the paternal traits. CA Sci. Framework, p 226 OES: pending PT: pending	**CA Bio**, Ch 11:1-2 ***Supplemental Resources:*** • **Crossing Over in Meiosis** www.accessexcellence.org/RC/VL/GG/comeiosis.php • CA Bio, Teacher to Teacher, and Demonstration, p. 277 TE Model Crossing-Over ***Key Vocabulary:*** segregation allele karyokinesis crossing over independent assortment	2 Days (1½ Blocks)
… new combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization). **(2d)** [CST, LS10]	• Explain that the formation of gametes with randomly segregated chromosomes is the first important step in sexual reproduction. • Explain how, in the second step of sexual reproduction, the chance union of two haploid gametes makes a genetically unique, diploid organism. • Diagram how sperm and egg fuse to form a zygote that combines genotypes of the parents to produce a new allelic composition for the offspring. • Read the genetic diploid karyotype of a fertilized egg and compare the allelic composition of offspring with the genotypes and phenotypes of the parents. ***Skills Focus:*** Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)**	***Key Assignments:*** - none - ***Suggested:*** • **Genetic Chart (Part II)** Create a chart to illustrate how the events of meiosis and the chance union of gametes lead to new combinations of alleles in a zygote. CA Sci. Framework, p 226 OES: pending PT: pending	**CA Bio**, Ch 11:1,4 ***Supplemental Resources:*** • **Gametogenesis:** http://people.uncw.edu/ballardt/ bio316/gametogenesis.pdf • **Genotype vs. Phenotype** http://www.brooklyn.cuny.edu/bc/ahp/BioInfo/SD.Geno.HP.html • **Making a Karyotype** http://learn.genetics.utah.edu/content/begin/traits/karyotype/index.html ***Key Vocabulary:*** zygote gamete fertilization	2 Days (1½ Blocks)
… why approximately half of an individual's DNA sequence comes from each parent. **(2e)** [CST, LS10]	• Describe a chromosome as a single, very long molecule of double-stranded DNA and proteins. • Define genes as segments of DNA that code for polypeptides (proteins). • Explain how, during fertilization, half of the DNA of the offspring comes from the gamete of one parent, and the other half comes from the gamete of the other parent. ***Skills Focus:*** Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)**	***Key Assignments:*** - none - ***Suggested:*** OES: pending PT: pending	**CA Bio**, Ch 11:4, 14:1 ***Supplemental Resources:*** • **DNA Presentation** http://www.dnaftb.org/dnaftb/15/concept/ • **Introduction to DNA Structure** http://www.blc.arizona.edu/Molecular_Graphics/DNA_Structure/DNA_Tutorial.HTML#Components • **DNA Structure and Coding** http://www.umass.edu/molvis/tutorials/dna/ ***Key Vocabulary:*** polypeptide DNA	1 Day (½ Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the role of chromosomes in determining an individual's sex. **(2f)** [CST, LS10]	• Recall that normal human somatic cells contain 46 chromosomes: 44 pairs of homologous chromosomes and 2 sex chromosomes. • Recall that females usually carry two X chromosomes in each somatic cell. • Recall that males possess one X chromosome and one smaller Y chromosome. • Explain that the sex of the offspring depends on the combination of these two sex chromosomes. ***Skills Focus:*** model Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)**	***Key Assignments:*** - none - ***Suggested:*** • **50/50 Lab** Use the flip of a coin to demonstrate the 50/50 probability of boy vs. girl babies. Use 12 – 18 groups (families) of six tosses (children) each. Compile class results and calculate ratios. OES: pending PT: pending	**CA Bio**, Ch 14:1 ***Supplemental Resources:*** ***Key Vocabulary:*** somatic cell sex chromosome homologous chromosomes	2 Days (1 Block)
… how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents. **(2g)** [CST]	• Explain that when genetic makeups of parents are known, all the possible assortments of alleles in their gametes can be determined for each gene. • Describe, in general terms, how considering all the possible pair-wise combinations of gametes allows prediction of the possible genetic makeups of offspring. *NOTE: Punnett Squares are introduced in Standard Set 3.* ***Skills Focus:*** model, analyze 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). **(I&E 1.i)**	***Key Assignments:*** - none - ***Suggested:*** • **Genetic Variation** Use a selection of dead flies. Viewing with magnification, observe variations in wings and eye colors. Chart the descriptions. OES: pending PT: pending	**CA Bio**, Ch 11:2-3, 14:1 ***Supplemental Resources:*** ***Key Vocabulary:*** allele gamete zygote	1 Day (½ Block)

Genetics (Mendel's Laws) ***5% CST***

3. A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time

… 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). **(3a)**
[CST, LS10]
	• Write genotypes and translate genotypes into phenotypes.
	• Use Punnett Squares and probability math to describe the possible gametes and predict possible offspring characteristics.
	• Explain how autosomal dominant and autosomal recessive alleles interact to express phenotypes.
	  ◦ Use monohybrid crosses to illustrate human disorders characterized by autosomal recessive alleles (such as albinism, cystic fibrosis, Tay-Sachs, and phenylketonuria (PKU)).
	  ◦ Contrast the expression of recessive alleles in the conditions mentioned above with disorders produced by the possession of just one autosomal dominant allele (such as Huntington Disease, dwarfism, and neurofibromatosis).
	• Explain the expression of incomplete dominance (such as seen in comparisons of curly, straight, and wavy hair or in the expression of flower colors in snapdragon plants).
	• Illustrate how sex-linked characteristics explain why males express conditions that are rare or not found in females (such as color-blindedness, hemophilia, fragile-X syndrome, and sex-linked muscular dystrophy).
	• Describe how monohybrid crosses can be used to determine parental genotypes and phenotypes.
	• Describe how dihybrid crosses can be used to determine the possible offspring genotypes and phenotypes.
	Skills Focus
	model, analyze
	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). **(I&E 1.i)**
		Key Assignments:
		• **Genetic Probability** [See description on p. 51.]
		Suggested:
		• **Lab: A Dihybrid Cross** Use a 10x10 kernel area of genetic corn on the cob. Count the phenotypes: yellow smooth, yellow wrinkles, purple smooth, purple wrinkled. Compile class results to determine ratio. Use ratios to identify dominant and recessive traits and 9:3:3:1 ratio.
		• **Lab: Distribution of Inherited Traits** Using index cards and paper bags, pull labeled "alleles" from "individuals" to make combinations of offspring. Explanation- Label a bag, "male" and a bag, "female". Write "B" on several index cards as the dominant allele for brown eye color, and "b" on several cards as the recessive allele for blue eye color. Pull random cards from bags and tally genotypes.
		• **Baby Face Activity** Students analyze their own genetic facial traits and pair up into "couples" to determine possible characteristics of a child.
		• CA Bio, Lab Manual (A), p. 107, "Investigating Inherited Traits"
		OES: pending
		PT: pending
			CA Bio, Ch 11:2, 14:1-2
			Supplemental Resources:
			• **Clermont College Biology: Genetics Practice Problems** http://biology.clc.uc.edu/courses/bio105/geneprob.htm
			• CA Bio, Use Visuals, Figure 11-2, p. 273 TE
			• CA Bio, Quick Lab, **"**How are Dimples Inherited?", p. 268
			• CA Bio, Lab Manual (B), p. 101, "Introduction to Genetics"
			Key Vocabulary:
			allele, genotype, phenotype, autosomal, dominant, recessive, sex-linked, gamete, Punnett Squares, offspring, probability, segregation, monohybred cross, filial, incomplete dominance
				5 Days (3 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the genetic basis for Mendel's laws of segregation and independent assortment. **(3b)** [CST]	• Explain how Gregor Mendel was able to deduce that each characteristic of an organism is controlled by two genes, one from each parent. • Diagram Mendel's explanation of how a parental trait can appear to vanish for a generation (first filial – F1) and then reappear in the next generation (second filial – F2). • Recall that alternate versions of a gene at a single locus are called alleles. • Recall that if the two alleles are different, the dominant one (if one is dominant) will be expressed over the recessive one. • Recall that Mendel's law of segregation results from the fact that alleles are separated (segregated) by meiosis when gametes are formed. • Explain that the law of segregation applies accurately when genes are located on separate chromosomes that segregate at random. • Explain how the law of segregation does not apply for combinations of genes that reside on the same chromosome. ***Skills Focus*** model, analyze Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.. **(I&E 1.e)**	***Key Assignments:*** - none - ***Suggested:*** • **Mendel Model** Students design and build models to illustrate the laws of segregation and independent assortment. CA Sci. Framework, p 228 OES: pending PT: pending	**CA Bio**, Ch 11:1-3,5 ***Supplemental Resources:*** • **Mendel Research** Students locate and study various resources that describe Mendel's logic. CA Sci. Framework, p 228 ***Key Vocabulary:*** allele gamete segregation independent assortment	4 Days (2½ Blocks)
… how to predict the probable mode of inheritance from a pedigree diagram showing phenotypes. ***(3c*)***	* *Use a pedigree diagram showing phenotypes to predict the mode of inheritance.* ***Skills Focus:*** model Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)**	***Key Assignments:*** - none - ***Suggested:*** • **Personalized Pedigree** Construct your own personal pedigree and trace single gene traits through your family – tongue curl, curve/straight thumb, widow's peak, etc. • CA Bio, Use Visuals, Figure 14-3, p. 342 TE OES: pending PT: pending	**CA Bio,** Ch 14:1 ***Supplemental Resources:*** ***Key Vocabulary:*** pedigree	1 Days (½ Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how to use data on frequency of recombination at meiosis to estimate genetic distances between loci and to interpret genetic maps of chromosomes. ***(3d*)***	∗ *Interpret genetic maps of chromosomes.* ∗ *Manipulate genetic data by using standard techniques to relate the frequency of recombination at meiosis to an estimate of genetic distances between loci.* ***Skills Focus:*** model, analyze 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). **(I&E 1.i)**	***Key Assignments:*** - none - ***Suggested:*** • CA Bio, Use Visuals, Figure 11-19 , p. 235 • Discovery Video: "The Human Genome Project" (available at the SMRC) OES: pending PT: pending	**CA Bio**, Ch 11:5 ***Supplemental Resources:*** • **Human Genome Project Main Page:** http://www.ornl.gov/sci/techresources/Human_Genome /home.shtml • **Video Listings related to the Human Genome Project:** http://www.ornl.gov/sci/techresources/Human_Genome/education/videos.shtml • **Human Genome Project Student Resources:** http://www.ornl.gov/sci/techresources/Human_Genome/education/students.shtml ***Key Vocabulary:*** DNA fingerprint genome	2 Days (1 Block)

Genetics (Molecular Biology) ***8.3% CST***

4. Genes are a set of instructions encoded in the DNA sequence of each organism that specify the sequence of amino acids in proteins characteristic of that organism.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA. **(4a)** [CST]	• Explain the twofold role of DNA: 1. store and transfer genetic information from one generation to the next. ***(Standard Sets 2 & 3 focus)*** 2. express that genetic information in the synthesis of proteins, thereby controlling the structure and function of all cells. ***(Standard Set 4 focus)*** • Recall that DNA does not leave the cell nucleus to produce proteins. • Explain how the DNA's code is carried to ribosomes in the cytoplasm (transcription) by complimentary strands of mRNA. • Recall that ribosomes translate mRNAs to make protein. • Recall that free-floating amino acids are bonded to specific tRNAs, which transport them to mRNA on the ribosome. • Demonstrate proper nitrogen base pair matching from DNA to RNA and from RNA to RNA. • Explain how the 3-nucleotide codons of mRNA are paired with the 3-nucleotide anticodons of tRNA as the ribosome moves along the mRNA strand. • Explain how the amino acids on the tRNAs are connected into a growing polypeptide in a sequence specified by the DNA code. ***Skills Focus:*** model, analyze Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)** 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). **(I&E 1.i)**	***Key Assignments:*** • **Protein Synthesis** [See description on p. 51.] • **Analogy Project** (possible) [See description on p. 50, top of Projects section.] ***Suggested:*** • **Transcription/Translation Activity (I)** Students simulate the process of converting DNA code to a polypeptide chain on paper or by using representative models. CA Sci. Framework, p 229 OES: pending PT: pending	**CA Bio**, Ch 12:3 ***Supplemental Resources:*** • CA Bio, Lab Manual (B), p. 105, "Building a DNA Model" ***Key Vocabulary:*** RNA, messenger RNA, ribosomal RNA, transcription, ribosomes, exons, interons, translation	4 Days (2 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA. **(4b)** [CST]	• Recall that in prokaryotes, mRNA is transcribed from the DNA as a single, continuous sequence. • Explain how, in eukaryotes, the initial RNA transcript is "edited" before leaving the nucleus. ° Recall that the initial RNA transcript contains exons (nucleotide sequences that are used for protein synthesis) and introns (sequences that are not used). ° Recall that before leaving the nucleus, introns are removed and exons are spliced together. ° Recall that the new, "edited" RNA is now properly called mRNA, and is ready to carry the codon sequence for a protein to a ribosome for translation. • Explain that within the mRNA, a start codon will signal the beginning of a sequence of codons to be translated, and a stop codon signals the end of the sequence to be translated into a protein. ***Skills Focus:*** model, analyze Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)** 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). **(I&E 1.i)**	***Key Assignments:*** - none - ***Suggested:*** • **Transcription/Translation Activity (II)** Students add the step of removing introns to their previous model of translation. They can also identify start and stop codons to determine the actual amino acid sequences of the protein to be produced using a table of the genetic code. CA Sci. Framework, p 230 • CA Bio, "The Genetic Code", Building Science Skills, Applying Concepts, p. 302 TE OES: pending PT: pending	**CA Bio**, Ch 12:3 ***Supplemental Resources:*** • CA Bio, Animated Bio Concepts DVD, 25, 26 • CA Bio, Quick Lab, p. 303, "How does a cell interpret DNA?" ***Key Vocabulary:*** amino acids, exons, interons, codons, start codons, stop codons	2 Days (1½ Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein. **(4c)** [CST]	• Define mutations as permanent changes in the sequence of nitrogen bases (the "code" part of the nucleotides) in DNA. • Explain that a mutation is created when nitrogen bases are not paired properly. • Explain that mutations usually do not improve the product coded by the gene. • Demonstrate how the deletion or addition of base pairs cause mutation by changing the 3-nucleotide per codon reading frame used by the ribosome. • Explain that mutations in somatic cells (any cell other than sperm or egg) are not passed on to offspring, but may cause cancer or other undesirable cellular changes. • Explain how mutations in germ cells (those that produce sperm or egg) can alter the proteins produced in every cell of a offspring organism, causing genetic diseases such as Tay-Sachs, sickle cell anemia, and Duchenne muscular dystrophy. ***Skills Focus:*** model, analyze Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)** Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena. **(I&E 1.i)** Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. **(I&E 1.m)**	***Key Assignments:*** - none - ***Suggested:*** • CA Bio, "Significance of Mutations", Building Science Skills, Classifying, p. 308 TE OES: pending PT: pending	**CA Bio**, Ch 12:4 ***Supplemental Resources:*** • CA Bio, Animated Bio Concepts DVD, 27, 28 ***Key Vocabulary:*** mutations base pairs protein synthesis amino acid sequence	3 Days (2 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves. **(4d)** [CST]	• Define gene expression as the process in which a gene codes for a product (usually protein) through transcription and translation. • Recall that nearly all cells in an organism contain the same DNA. • Explain that each cell transcribes only the portions of DNA containing the genetic information for proteins required at that specific time by that specific cell. • Explain that some portions of the DNA are not expressed. • Explain that specific types of cells produce proteins unique to that type of cell, meaning they transcribe a portion of DNA that is not transcribed in any other cell. ***Skills Focus:*** model, analyze Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)** 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). **(I&E 1.i)**	***Key Assignments:*** - none - ***Suggested:*** • CA Bio, Universal Access, Advanced Learners, p. 310 TE OES: pending PT: pending	CA Bio**, Ch 12:5** ***Supplemental Resources:*** • *(See web resources listed for standard 3d.)* • CA Bio, Address Misconceptions, p. 311 TE ***Key Vocabulary:*** gene expression	2 Days (1½ Blocks)
… proteins can differ from one another in the number and sequence of amino acids. **(4e)** [CST]	• Recall that proteins are chains of amino acids varying from 50 to 3,000 units long. • Explain that the types, sequences, and numbers of amino acids determine the type of protein produced. Note: This is a "big picture", context-setting standard. You may wish to include some details of 4f to explain why the proteins end up being different types. ***Skills Focus:*** compare	***Key Assignments:*** - none - ***Suggested:*** OES: pending PT: pending	**CA Bio**, Ch 2:3 ***Supplemental Resources:*** • **Structures of Life (NIH)** http://publications.nigms.nih.gov/ structlife/ ***Key Vocabulary:*** sequence	½ Day (½ Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… why proteins having different amino acid sequences typically have different shapes and chemical properties. ***(4f*)***	∗ *Recall that the 20 different protein-making amino acids have the same basic structure: an amino group, an acidic carboxyl group, and an R (radical) group.* ∗ *Identify the peptide bond as the link between the amino group of one amino acid and the carboxyl group of another.* ∗ *Describe the resulting protein (polypeptide) as a long molecular chain with the R groups attached along the polymer backbone.* ∗ *Explain that the properties of amino acids vary because of their order in the peptide chain and the chemical properties of their R groups.* ° *Identify the atoms found in the different R groups of amino acids as carbon, hydrogen, nitrogen, oxygen, and sulfur.* ° *Recall that sulfur containing amino acids sometimes play an important role of cross-linking and stabilizing polymer chains.* ∗ *Explain that long protein molecules typically fold upon themselves, creating a three-dimensional structure that determines the unique properties and function of each protein.* ° *Explain and cite examples of how structure allows proteins to be highly specific catalysts or enzymes, able to position and hold other molecules.* ° *Explain that the R groups cause variation in the chemical and physical properties of proteins, such as solubility in water, electrical charge, size, and shape.* ***Skills Focus:*** model, analyze Analyze situations and solve problems that require combining and applying concepts from more than one area of science. **(I&E 1.l)**	***Key Assignments:*** - none - ***Suggested:*** OES: pending PT: pending	**CA Bio**, Ch 2:3 ***Supplemental Resources:*** • **Molecular Movies: Protein Folding and Stability** http://www.molecularmovies.com/showcase/index.html#folding • **Amino Acid Basics** http://www.johnkyrk.com/aminoacid.html • **Florida State Univ.: Quick Functional Description for Each Amino Acid** http://micro.magnet.fsu.edu/aminoacids/ • **Biochemistry of Amino Acids** http://themedicalbiochemistrypage.org/ • **Stanford Protein Folding Website** http://folding.stanford.edu/English/Science • **Structures of Life (NIH)** http://publications.nigms.nih.gov/ structlife/ ***Key Vocabulary:*** amino group R group acidic (carboxyl) group polymer **peptide bond** polymer chain	3 Days (1½ Blocks)

Genetics (Biotechnology) ***6.7% CST***

5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the general structures and functions of DNA, RNA, and protein. **(5a)** [CST, LS10]	• Recall that nucleic acids (DNA and RNA) are polymers composed of monomers called nucleotides. ° Identify the three parts of nucleotides: a pentose (5-carbon) sugar, a phosphoric acid group, and a nitrogen base. ° Distinguish the deoxyribose of DNA from the ribose of RNA. ° Recall the four nitrogen bases of DNA (adenine, guanine, cytosine, and thymine) and how they pair. ° Explain how base pairing is the reason DNA acts as a template for its own replication. ° Explain that only a small part of the DNA is expressed in any given cell, meaning that genes are turned on or off as needed by the cell, producing only what is needed when it is needed. ° Recall that the nitrogen bases of RNA are the same as DNA except that thymine is replaced by uracil. ° Recall that DNA is a double stranded molecule, while RNA is a single strand. ° Recognize the different functional forms of RNA: mRNA serving as a template recognized by the codons of aminoacylated tRNAs, and rRNA, which along with proteins, comprises ribosomes. • Recall that proteins are polymers composed of monomers called amino acids. (See also standard 1h.) ° Identify the different functions of proteins: enzymes, transport molecules, hormones, structural components of cells, and antibodies that fight infections. ***Skills Focus:*** model, analyze 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). **(I&E 1.i)**	***Key Assignments:*** • **DNA Isolation** [See description on p. 51.] ***Suggested:*** • CA Bio, Lab Manual (A), p. 113, "Extracting DNA" OES: pending PT: pending	**CA Bio**, Ch 12:1,3 ***Supplemental Resources:*** • **Molecular Movies: DNA Chromatin** http://www.molecularmovies.com/showcase/index.html#dna • **Molecular Movies: RNA Stability & RNAi** http://www.molecularmovies.com/showcase/index.html#rnai • **Molecular Movies: Translation** http://www.molecularmovies.com/showcase/index.html#translation ***Key Vocabulary:*** exogenous DNA, nucleotides, RNA, base pairing, polymers, enzymes, DNA (nitrogen bases, pentose sugar phosphoric acid group)	4 Days (2 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how to apply base-pairing rules to explain precise copying of DNA during semi-conservative replication and transcription of information from DNA into mRNA. **(5b)** [CST]	• Describe how DNA replication begins with enzymes unzipping, or unwinding, the double helix to separate the two parental strands. • Explain how DNA replication usually starts in a small region, forming a "replication bubble" that expands as it unwinds the double strand and spreads in both directions along the chromosome. • Explain how, as the parental strands separate, they serve as a template for new daughter strands. ° Describe the process of binding complementary nucleotides to the parental strand following base-pairing rules. ° Describe the details of how the "lagging" daughter strand forms along the "leading" parental strand in short fragments ("primed" or started by small RNA sequences) that are later repaired and connected together. ° Explain how DNA replication is semiconservative in that one parental strand is conserved and joined to a newly synthesized complementary strand. • Explain how RNA is produced by transcribing a section of DNA containing the nucleotide sequence that codes for a specific protein. • Explain that transcription only occurs on the template DNA strand, not the complementary strand. • Recall that RNA (mRNA, specifically) leaves the nucleus and goes to ribosomes in the cytoplasm, where protein synthesis takes place. ***Skills Focus:*** Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)** 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). **(I&E 1.i)** Recognize the cumulative nature of scientific evidence. **(I&E 1.k)**	***Key Assignments:*** - none - ***Suggested:*** • **DNA Replication Modeling** Students create a model to the process of DNA replication showing: 1. leading and lagging strands 2. semiconservative process 3. the antiparallel orientation of the deoxyribose/phosphate side chains of DNA that requires repeated reinitiation of the lagging strand synthesis 4. RNA primers that initiate replication of the daughter DNA fragments CA Sci. Framework, p. 232-233 OES: pending PT: pending	**CA Bio**, Ch 12:2 ***Supplemental Resources:*** • **Molecular Movies: Transcription** http://www.molecularmovies.com/showcase/index.html#transcription ***Key Vocabulary:*** DNA replication template replication fork semiconservative replication	3 Days (2 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time

… how genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products. **(5c)**
 	
[CST]
	• Define recombinant DNA as containing DNA from two or more different sources.
	• Describe how viruses and bacterial plasmids can serve as vectors to introduce recombinant DNA into a host cell.
	• Explain the role of restriction enzymes (a.k.a., endonucleases) in cutting DNA into specific gene fragments at desired locations and leaving "sticky ends" to facilitate bonding into vector DNA.
	• Explain how cloning or polymerase chain reactions produce large numbers of copies, amplifying the gene.
	• Describe the process of commercially producing products using recombinant DNA.
	  ° Describe how recombinant cells are grown in large fermentation vessels.
	  ° Explain that the product of the inserted DNA is either extracted from the cells, or from the medium if the product is secreted by the cells.
	  ° Explain that the products are then purified.
	• Explain that the purpose of recombinant DNA technology is to isolate and exchange DNA between organisms to fulfill a specific human purpose.
	  ° Explain the benefits of using microorganisms to commercially produce human insulin, human growth hormone, blood clotting factors, and many other products this way.
	  ° Cite specific examples of various agricultural applications of recombinant DNA technology, including increased productivity of food crops and animals, increased resistance to pests, herbicides, and viruses, and greater ability to face harsh environmental conditions.
	
	Skills Focus:
	[*Investigating careers in Biotechnology*] Know important strategies for self-promotion in the hiring process, such as job applications, resume writing, interviewing skills, and preparation of a portfolio. **(FS 3.6)**
	
	Understand the importance of accountability and responsibility in fulfilling personal, community, and workplace roles. **(FS 7.2)**
	
	Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. **(I&E 1.m & FS 5.3)**
		Key Assignments:
		- none -
		
		Suggested:
		• **Modeling Recombinant DNA**
		Students simulate the process of inserting an antibiotic resistance gene into an organism by manipulating DNA (paper strips) using restriction enzymes (scissors) and DNA ligase (tape). Plan the activity so that students will visualize how restriction enzymes often make staggered cuts that create "sticky ends" and how these ends must be matched during ligation.
		CA Sci. Framework, p. 233
		
		OES: pending
		PT: pending
			CA Bio, Ch 13:1-4
			
			Supplemental Resources:
			• **Rensslaer Chem & Bio Engineering: Recomb. DNA** http://rpi.edu/dept/chem-eng/Biotech-Environ/Projects00/rdna/rdna.html
			• **Bio-Rad Resources** http://www.bio-rad.com/
			• CA Bio, Quick Lab, p. 326, "How can restriction enzymes be modeled?"
			
			Key Vocabulary:
			vectors
			restriction enzymes
			vaccine
			transgenic animal
			Human Genome Project
			sticky ends
			PCRs
			gene therapy
			DNA ligation
				3 Days (2 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, ligation, and transformation) is used to construct recombinant DNA molecules. ***(5d*)***	∗ *Explain how when a desired gene is identified, restriction enzymes (endonucleases) are used to cut the DNA into fragments.* ∗ *Explain that restriction enzymes typically cut the DNA leaving palindromic (read the same forward and backward) portions of DNA that form complementary sticky ends.* ∗ *Describe how DNA fragments are separated from one another by gel electrophoresis.* ° *Describe how DNA that has been cut into fragments by restriction enzymes is placed into rectangular depressions made in a jello-like material, called agarose gel.* ° *Explain that the DNA fragments are pushed through a layer of the gel by an electric current.* ° *Explain how each DNA fragment travels through the gel at a different speed, which is determined by its size, shape, and electrical charge. (Smaller size and higher charged particles move faster.)* ° *Explain how the different fragments spread out through the gel, like runners in a race, and that with proper staining techniques, they can be easily seen and removed directly from the gel for further analysis or recombination.* ∗ *Explain that DNA ligase binds the sticky ends of the desired gene fragment into a prepared DNA vector fragment.* ***Skills Focus:*** model Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)** 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). **(I&E 1.i)**	***Key Assignments:*** - none - ***Suggested:*** • CA Bio, Lab Manual (A), p. 119, "Investigating Gel Electrophoresis" OES: pending PT: pending	**CA Bio**, Ch 13:2 ***Supplemental Resources:*** • **Univ. of Utah: Gel Electrophoresis Virtual Lab** http://learn.genetics.utah.edu/content/labs/gel/ • **Colorado State Univ.: Agarose Gel Electrophoresis of Restriction Fragments** http://www.vivo.colostate.edu/hbooks/genetics/biotech/gels/virgel.html • **Electrophoresis Simulator** http://webphysics.davidson.edu/applets/biogel/biogel.html ***Key Vocabulary:*** restriction enzymes *(endonucleases)* gel electrophoresis palindromic	3 Days (1½ Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products. ***(5e*)***	* *Define transformation as the process of inducing bacteria to take up recombinant plasmids.* * *Explain that bacteria reproduce the recombinant DNA along with their own as they replicate.* * *Explain how the rapid growth rate of bacteria allows billions of copies of recombinant DNA to be obtained.* * *Explain that DNA transformation occurs in nature, and can be done without recombinant DNA technology as is seen in selective breeding of pets and of agricultural crops.* ***Skills Focus:*** analyze Formulate explanations by using logic and evidence. **(I&E 1.d)** Use critical thinking skills to make informed decisions and solve problems. **(FS 5.3)**	***Key Assignments:*** - none - ***Suggested:*** • **Plasmid DNA Transformation:** Commercially available kits may be obtained through major vendor catalogs. CA Sci. Framework, p. 234 OES: pending PT: pending	**CA Bio**, Ch 13:3 ***Supplemental Resources:*** • **Recombinant Plasmid—Insulin Synthesis:** http://www3.iptv.org/exploremore/ge/what/insulin.cfm ***Key Vocabulary:*** exogenous DNA plasmid DNA transformation	2 Days (1 Block)

Ecology

11.7% CST

6. Stability in an ecosystem is a balance between competing effects.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats. **(6a)** [CST, LS10]	• Define biodiversity as the collective variety of all living organisms in an ecosystem. • Identify factors that impact biodiversity, including climatic changes, fire, flood, and invasion by organisms from another system. • Explain why greater diversity in an ecosystem gives greater stability. ***Skills Focus:*** observe Formulate explanations by using logic and evidence. **(I&E 1.d)** Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena. **(I&E 1.i)**	***Key Assignments:*** • **Ecology Observations** [See description on p. 51.] ***Suggested:*** • **Virtual Ecosystems** Students can observe virtual ecological experiments from Internet sources, or even create their own ecological experiments using modeling programs (such as EcoBeaker). CA Sci. Framework, p 235 • **Ecology Guest Expert** Invite a government, private, or university ecologist to share their work with a group of classes. CA Sci. Framework, p 235 • **Actual Ecosystems** Design and carry out careful observation and monitoring of an ecosystem over time. CA Sci. Framework, p 235 OES: pending PT: pending	**CA Bio**, Ch 6:3 ***Supplemental Resources:*** • **Scientific American: Latest Articles on Biodiversity** http://www.scientificamerican.com/topic.cfm?id=biodiversity • **Stanford Encyclopedia of Philosophy** http://plato.stanford.edu/entries/biodiversity/ • **Chevron Biodiversity Statement** http://www.chevron.com/globalissues/environment/biodiversity/?gclid=CNCsqPnru6ICFQQxiQodRx7y5g • **Port of Long Beach: Environment Links** http://www.polb.com/environment/default.asp ***Key Vocabulary:*** biodiversity habitat community ecosystem biotic and abiotic factors population	2 Days (1 Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of non-native species, or changes in population size. **(6b)** [CST, LS10]	• Explain that changes in ecosystems are often predictable by understanding climate patterns, seasonal reproductive cycles, population cycles, and migrations. • Describe how unexpected disturbances, such as those caused by human intervention or the introduction of a new species, may destabilize the complex balance in an ecosystem. • Explain that analyzing changes in ecosystems is difficult because of the interconnection of many simultaneous cycles and factors. • Explain that patterns and rates of change, whether linear trends, regular cycles, or irregularities, provide useful data for understanding ecosystems. • Explain that it is important to observe changes in an ecosystem over time (longitudinal analysis) to gain useful understanding, make reasonable predictions, and when possible, plan ways to positively influence an ecosystem. ***Skills Focus:*** inference, observe, measure 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. **(I&E 1.a)** Formulate explanations by using logic and evidence. **(I&E 1.d)** Use critical thinking skills to make informed decisions and solve problems. **(FS 5.3)** Understand the importance of accountability and responsibility in fulfilling personal, community, and workplace roles. **(FS 7.2)** Understand the role of personal integrity and ethical behavior in the workplace. **(FS 8.3)** Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)** 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). **(I&E 1.i)**	***Key Assignments:*** - none - ***Suggested:*** • CA Bio, Inquiry Activity, p. 138, "What happens to household trash?" OES: pending PT: pending	**CA Bio**, Ch 5:1, 6:1-4 ***Supplemental Resources:*** • CA Bio, Lab Manual (A), p. 79, Investigating Air and Water Pollution • CA Bio, Design an Experiment, "Observing the Effects of Acid Rain", p. 161 ***Key Vocabulary:*** longitudinal analysis population density carrying capacity symbiosis greenhouse effect mutualism coevolution competition pyramids niches CFC acid rain commensalism parasitism	4 Days (2 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death. **(6c)** [CST, LS10]	• Explain that because it is difficult to directly measure the total population of organisms, population fluctuations are estimated by observing relative rates of birth, death, immigration, and emigration in a population. • Explain that comparing death and emigration to birth and immigration, will show if the population will grow or decline over time. ***SKILLS FOCUS:*** microscopy, data collection Use critical thinking skills to make informed decisions and solve problems. **(FS 5.3)**	***Key Assignments:*** - none - ***Suggested:*** • CA Bio, Analyzing Data, p. 123, "Population Trends" OES: pending PT: pending	**CA Bio**, Ch 5:1-3 ***Supplemental Resources:*** • CA Bio, Inquiry Activity, p. 118, "How do populations grow?" • CA Bio, Quick Lab, p. 125, "How does competition affect growth?" ***Key Vocabulary:*** immigration emigration	2 Days (1 Block)
… how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration. **(6d)** [CST, LS10]	• Explain how organisms depend on non-living natural resources. • Explain how, at the molecular level, organisms depend on chemical cycles of water, carbon, nitrogen, phosphorus and other elements. ° Describe and illustrate how water, carbon, and nitrogen enter the biosphere through photosynthesis and nitrogen fixation in producers and are used by consumers for food and protein synthesis. ° Describe and illustrate how respiration, excretion of waste products, and death recycle chemicals back to the non-living environment. ***Skills Focus:*** diagram	***Key Assignments:*** - none - ***Suggested:*** • Have students create complete physical cycles with labels. OES: pending PT: pending	**CA Bio**, Ch 3:2-3 ***Supplemental Resources:*** • CA Bio, Analyzing Data, p. 79, "Farming in the Rye" • CA Bio, Real-World Lab, Identifying a Limiting Nutrient, p. 81 ***Key Vocabulary:*** producers consumers transpiration respiration combustion erosion assimilation ammonification nitrification denitrification biogeochemical cycles	2 Days (1 Block)
… a vital part of an ecosystem is the stability of its producers and decomposers. **(6e)** [CST, LS10]	• Define the role of producers (plants and photosynthetic microorganisms) as primarily responsible for producing organic matter. • Define the role of decomposers (fungi and microorganisms) as primarily responsible for recycling organic matter. • Explain and provide examples of how conditions that threaten the stability of producer and consumer populations jeopardize the availability of energy and matter to the rest of the biological community. ***SKILLS FOCUS:*** model Use critical thinking skills to make informed decisions and solve problems. **(FS 5.3)**	***Key Assignments:*** - none - ***Suggested:*** • **Producers & Consumers** Have students study the interactions of producers and decomposers in a closed or restricted ecosystem, such as a worm farm, a composting system, a terrarium, or an aquarium. CA Sci. Framework, p 236 OES: pending PT: pending	**CA Bio**, Ch 3:2, 21:3 ***Supplemental Resources:*** ***Key Vocabulary:*** producers consumers decomposers trophic level	1 Day (½ Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… at each link in a food web some energy is stored in newly made structures but much is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid. **(6f)** [CST, LS10]	• Design and illustrate energy pyramids for specific ecosystems. • Describe how organisms at each level of a food web store about 10 percent of the energy they take in within structures. • Describe how about 90 percent of the energy is used metabolically to survive and is released to the environment as heat. • Explain and illustrate how at each link in a food web, or level in an energy pyramid, only 10 percent of the energy is passed from an organism to its consumer. ***Skills Focus:*** analyze, illustrate	***Key Assignments:*** - none - ***Suggested:*** • Calculations of Energy Loss OES: pending PT: pending	**CA Bio**, Ch 6:3 ***Supplemental Resources:*** • **Links to Food Web/Energy Pyramid Websites.** http://www.ftexploring.com/links/foodchains.html ***Key Vocabulary:*** producers, consumers, trophic levels, food chain, food web, decomposers, omnivores, herbivores, carnivores, detrifivores, primary, secondary, tertiary	2 Days (1 Block)
… how to distinguish between the accommodation of an individual organism to its environment and the gradual adaptation of a lineage of organisms through genetic change. ***(6g*)***	• *Explain how organisms adapt to changing environments through non-genetic means or through natural selection of genetic traits.* ° *Describe how organisms can adapt to environmental changes by non-genetic accommodations in their structure, metabolism, or behavior.* ° *Describe how natural selection changes a population of organisms over time by encouraging the reproduction of organisms with favorable combinations of alleles governing structure, metabolism, and/or behavior.* • *Illustrate through examples how some organisms adapt to their environments through learned changes in behavior, and others are unsuccessful in learning survival skills.* • *Explain why it is difficult to distinguish between genetic and behavioral adaptations.* ° *Explain that physical changes often require careful measurements over many years and the examination of fossil ancestors to detect adaptation through genetic change.* ° *Explain that since genetic change can cause behavioral changes, it can be a very complicated process to separate genetic from behavioral accommodation to environmental change.* ***Skills Focus:*** data collection, predict Formulate explanations by using logic and evidence. **(I&E 1.d)** Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. **(I&E 1.m)**	***Key Assignments:*** - none - ***Suggested:*** • **Research Successful and Unsuccessful Behavioral Adapations** Students use print or online resources to research the effects of encroaching urbanization on undeveloped land and consider its effects on specific endangered and non-endangered species. CA Sci. Framework, p 237 • **Adaptations Reports** Group reports on organism adaptations by behavior • **Adaptation Observations** Make observations of animal behaviors/changes that may be a positive adaptation. OES: pending PT: pending	**CA Bio**, Ch 6:3 ***Supplemental Resources:*** ***Key Vocabulary:*** distribution curve, behavior	2 Days (1 Block)

Evolution (Population Genetics) ***6.7% CST***

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.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… why natural selection acts on the phenotype rather than the genotype of an organism. **(7a)** [CST, LS10]	• Explain and provide examples showing that natural selection works directly on expressed traits (the phenotype). • Explain that natural selection will have the same influence on an organism whether its phenotype is caused by the expression of a homozygous dominant genotype or of the dominant allele in a heterozygous genotype. ***Skills Focus:*** analyze, provide evidence Select and use appropriate tools and technology to perform tests, collect data, analyze relationships, and display data. **(1&E 1.a)** Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** • **Natural Selection Activity** [See description on p. 51.] ***Suggested:*** • CA Bio, Exploration, p. 387, Modeling Adaptation OES: pending PT: pending	**CA Bio**, Ch 15:3, 16:2 ***Supplemental Resources:*** • CA Bio, Lab Manual (A), p. 131, Comparing Adaptations of Birds ***Key Vocabulary:*** phenotype, genotype, allele, homozygous, heterozygous, recessive, dominant	2 Days (1 Block)
… why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool. **(7b)** [CST, LS10]	• Distinguish homozygous and heterozygous genotypes. ° Distinguish dominant, codominant, and recessive homozygous allele pairings. • Define recessive lethal alleles, such as the one responsible for Tay-Sachs disease. • Explain how healthy heterozygous individuals contribute the masked recessive gene to the gene pool, allowing the lethal alleles to persist in the population. ***Skills Focus:*** computer modeling Select and use appropriate tools and technology to perform tests, collect data, analyze relationships, and display data. **(1&E 1.a)** Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • Variety of Punnett Square activities to demonstrate genotypes vs. phenotypes. Ecosystem Observations. OES: pending PT: pending	**CA Bio**, Ch 14:2 ***Supplemental Resources:*** • CA Bio, Quick Lab, p. 351, "How is colorblindness transmitted?" ***Key Vocabulary:*** phenotype, genotype, allele, homozygous, heterozygous, recessive, dominant, codominant, incomplete dominance, sex linked trait	1 Day (½ Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… new mutations are constantly being generated in a gene pool. **(7c)** [CST, LS10]	• Explain that random changes in chromosomes occur through additions, deletions, substitutions of nucleotides, and rearrangement of chromosomes. • Explain that such mutations are an important source of new genetic variation within a gene pool. • Explain that many mutations have little or no effect on the reproduction or survival of the organism, while others may be harmful or beneficial. • Explain that a particular form of a trait cannot be selectively removed or bred out of a population because new, spontaneous mutations can cause that form of the trait to reappear. ***Skills Focus:*** analyze, research Formulate explanations by using logic and evidence. **(I&E 1.d)** Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. **(I&E 1.m)**	***Key Assignments:*** - none - ***Suggested:*** • **Research paper** Students make presentations on Sickle Cell Anemia and Malaria resistance. OES: pending PT: pending	**CA Bio**, Ch 16:1 ***Supplemental Resources:*** • **UC Berkeley: Causes of Mutations** http://evolution.berkeley.edu/evolibrary/article/0_0_0/mutations_04 • **Guest Speaker** Genetic Counselor presentation ***Key Vocabulary:*** mutation translocation inversion point mutation	1½ Days (1 Block)
… variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions. **(7d)** [CST, LS10]	• Describe and give examples of how changing environmental factors will change how natural selection impacts populations. • Explain how mutation and/or genetic recombination cause variation within a species, which in turn makes it more likely that at least some members of the species will survive environmental changes. • Explain why genetic sameness means vulnerability that could lead to extinction. ***Skills Focus:*** model, analyze, infer Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • CA Bio, Lab Manual (B), p. 123, Modeling Natural Selection OES: pending PT: pending	**CA Bio**, Ch 15:3, 16:1 ***Supplemental Resources:*** ***Key Vocabulary:*** genetic drift recombination	1½ Days (1 Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the conditions for Hardy-Weinberg equilibrium in a population and why these conditions are not likely to appear in nature. ***(7e*)***	• *Explain that the Hardy-Weinberg equations are only valid for large populations and randomly mating organisms that are not changing over time.* • *Explain that predictions made using the Hardy-Weinberg equations do not take into account changing environmental conditions, natural selection, migrations, or mutations – all of which will change the frequency of alleles in a population.* ***Skills Focus:*** justify Formulate explanations by using logic and evidence. **(I&E 1.d)** Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)**	***Key Assignments:*** - none - ***Suggested:*** OES: pending PT: pending	**CA Bio**, Ch 16:2 ***Supplemental Resources:*** • **Hardy-Weinberg Conditions** http://www.k-state.edu/parasitology/biology198/hardwein.html ***Key Vocabulary:*** Hardy-Weinberg Principle	2 Days (1½ Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how to solve the Hardy-Weinberg equation to predict the frequency of genotypes in a population, given the frequency of phenotypes. ***(7f*)***	• *Describe the purpose of the Hardy-Weinberg equation as a way to estimate allele frequencies in a population based on observations of phenotypes.* • *Explain how to show the frequency of different alleles in a population.* ° *Symbolize the possible allele frequencies for simple, two-allele traits as **p** for one possible allele and **q** for the other.* ° *Explain why **p + q = 1**, showing that, for instance, if half of the alleles were of one type (**p** = 0.5) the other half must be of the other type (**q** = 0.5);* ***p** + **q** = 0.5 + 0.5 = 1* • *Explain how to determine the frequencies of genotypes in diploid organisms.* ° *Symbolize the possible genotypes for homozygous organisms (**pp** or **qq**) and heterozygous (**pq** or **qp**) organisms.* ° *Explain that the genotypes appear at frequencies that are the product of the allele frequencies:* * *The frequency of **pp** organisms is p^2.* * *The frequency of **qq** organisms is q^2.* * *The frequency of heterozygous organisms, **pq** and **qp**, is **qp** + **pq**, or **2pq** (since **pq** and **qp** are the same thing.)* ° *Show how to account for the three distinguishable diploid genotype frequencies possible in a population by adding the homozygous and heterozygous frequencies:* $p^2 + 2pq + q^2 = 1$ • *Calculate the percentage of individuals with the various genotypes.* • *Calculate the genotype prevalence from observational data of phenotypes by working the equation in reverse.* ***Skills Focus:*** calculate Formulate explanations by using logic and evidence. **(I&E 1.d)** Recognize the usefulness and limitations of models and theories as scientific representations of reality. **(I&E 1.g)**	***Key Assignments:*** - none - ***Suggested:*** • **H-W Application** Have students calculate frequencies of alleles and offspring genotypes in large, randomly mixing spawning situations which would allow Hardy-Weinberg equilibrium to operate. CA Sci. Framework, p 240 • CA Bio, Solving Problems Using Hardy-Weinberg, Build Science Skills, Inferring, p. 401 TE OES: pending PT: pending	**CA Bio**, Ch 16:2 ***Supplemental Resources:*** • **Hardy-Weinberg Animations, Tutorials, and Practice** http://nhscience.lonestar.edu/biol/hwe.html ***Key Vocabulary:*** Hardy-Weinberg equation	2 Days (1 Block)

Evolution (Speciation)

8.3% CST

8. Evolution is the result of genetic changes that occur in constantly changing environments.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how natural selection determines the differential survival of groups of organisms. **(8a)** [CST, LS10]	• Recall that genetic changes are the result of either gene recombination during gamete formation or mutations. ° Explain how these genetic changes lead to variety and diversity within each species. • Explain and site examples of how natural selection favors organisms that best suited to their immediate environment. ° Explain how the selection for adaptive traits is realigned when the environment changes. ° Provide an example of how traits that were once adaptive may become disadvantageous. ° Explain that organisms not well suited to their environment may die before they can reproduce, and therefore do not pass on their traits to the next generation. ***Skills Focus;*** Identify and communicate sources of unavoidable experimental error. **(I&E1.b)** Formulate explanations by using logic and evidence. **(I&E 1.d)** Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e. g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong. **(I&E 1.n)**	***Key Assignments:*** - none - ***Suggested:*** • **Natural Selection Activity** Students explore natural selection through activities that simulate predator-prey relationships where organisms struggle to obtain food or escape becoming food. CA Sci. Framework, p 240 • Expand natural selection activities to demonstrate a variety of affecting factors and outcomes. OES: pending PT: pending	**CA Bio**, Ch 15:3, 16:3 ***Supplemental Resources:*** ***Key Vocabulary:*** recombination divergence natural selection speciation isolation	2 Days (1 Block)
… a great diversity of species increases the chance that at least some organisms survive major changes in the environment. **(8b)** [CST, LS10]	• Explain that, just as variation within a species helps members of the species to survive environmental changes (Standard 7d), so a variety of species within an ecosystem leads to greater chance of having some organisms survive changes. ***Skills Focus:*** research Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** CA Sci. Framework, p 235 • **Reports on Rainforest Species** Students research species that are closely reliant on each other. Students work as groups and report on the effects when one or more species is disrupted. Focus Question: Would fewer or more relationships better protect the survival of the ecosystem? OES: pending PT: pending	**CA Bio,** Ch 15:3, 16:3 ***Supplemental Resources:*** • **Guest Experts** Invite local scientists from CSULB, El Dorado Nature Center, Long Beach Aquarium, County Sanitation Districts, or oil companies to share ecological data they collect and experiments they perform. ***Key Vocabulary:*** **biodiversity**	2 Days (1 Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the effects of genetic drift on the diversity of organisms in a population. **(8c)** [CST]	• Define genetic drift as a random change in gene frequencies that may occur when a small sample of individuals is randomly separated from a larger population • Explain that the shift in gene frequency (or genetic drift) of the small population is random and may not be adaptive (helpful). • Recall mechanisms by which genetic drift may occur. ° Give examples of the *bottleneck effect* (i.e., nonselective population reductions due to disasters). ° Give examples of the *founder effect* (i.e., colonization of a new habitat by a few individuals). ***Skills Focus*** Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • **Graphic Representation** Students create a chart of diagram to illustrate the how genetic drift occurs in a population. OES: pending PT: pending	**CA Bio**, Ch 16:2 ***Supplemental Resources:*** • **Genetic Drift Simulation** http://www.biology.arizona.edu/evolution/act/drift/drift.html ***Key Vocabulary:*** genetic drift bottleneck effect founder effect	1 Day (½ Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… reproductive or geographic isolation affects speciation. **(8d)** [CST]	• Explain how reproductive isolation of different populations of the same species may lead to new species. ° Define **prezygotic** (before fertilization) **barriers** to reproduction as those that prevent mating, such as isolation of habitats, differences in breeding season or mating behavior, or an incompatibility of genitalia or gametes. ° Define **postzygotic** (after fertilization) **barriers** to reproduction as the genetic incompatibilities that prevent the development of viable or fertile hybrids. • Explain that speciation can occur within the same geographic range as the parent population *(sympatric speciation)* or in a geographically isolated location *(allopatric speciation)*. ° Explain that sympatric speciation is much more common in plants than in animals, because the genetic differences that develop are likely to interfere with sexual determination, which is less important for plants than it is for animals. ° Explain the allopatric speciation occurs when populations are separated and adapt to different environmental conditions. ° Explain that allopatric speciation occurs faster in a small population than in a large one because of greater genetic drift. ***Skills Focus:*** research, analyze Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • **Rift Research** Students report on the Rift Valley in Africa to find evidence of isolation effects. OES: pending PT: pending	**CA Bio**, Ch 16:3 ***Supplemental Resources:*** • **Notes/Diagrams on Speciation: Brown University** http://biomed.brown.edu/Courses/BIO48/21.Models.HTML ***Key Vocabulary:*** prezygotic, postzygotic, ecological, niches, allopatric, sympatric	2 Days (1 Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction. **(8e)** [CST, LS10]	• Explain that interpretation of the fossil record indicates that major changes have occurred within Earth's biosphere – called macroevolution. ° Contrast macroevolution with microevolution – the small genetic changes within a single population. ° Recall that four major explosions of life that follow mass extinctions are observed in the fossil record corresponding to the Precambrian, Paleozoic, Mesozoic, and Cenozoic eras. ° Explain that because DNA evidence is very rare in fossils, the study of biological diversity in the distant past is limited to differences among species instead of differences within species. • Explain that episodes of speciation are most dramatic after the appearance of novel characteristics, such as feathers and wings, or after mass extinction has cleared the way for new species. • Explain why extinction is inevitable in a changing world. ° Explain why mass extinctions coincide with rapid global environmental changes. ***Skills Focus:*** model, analyze, infer, measure Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • CA Bio, Analyzing Data, p. 438, Changing Number of Marine Families OES: pending PT: pending	**CA Bio**, Ch 16:2, 17:1,3-4, 29:1 ***Supplemental Resources:*** ***Key Vocabulary:*** paleontologist vestigial structures homologous structures	2 Days (1 Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how to use comparative embryology, DNA or protein sequence comparisons, and other independent sources of data to create a branching diagram (cladogram) that shows probable evolutionary relationships. ***(8f*)***	• *Define systematics as the study that connects the biological diversity observed to evolutionary history of species (phylogeny).* ° *Explain that classification is based on similarities between species.* ° *Describe some similarities (homologies) in embryonic development (ontogeny) that may be attributed to common ancestry.* ° *Note that the old assertion the "ontology recapitulates phylogeny" (i.e., that embryonic development replays the entire evolutionary history of a species) is no longer considered valid.* ° *Recall examples of homologous structures (such as forelimbs of cats, whales, and bats) that also provide evidence of a common origin.* ° *Explain how similarities between species can also be evaluated at the molecular level by comparing amino acids in proteins or nucleotide sequences of DNA.* • *Describe how approaches for using comparison information to classify organisms differ greatly.* ° *Explain and apply* ***cladistics*** *(creating branching cladograms) to diagram possible evolutionary sequences based on development of characteristics.* ° *Show that the extent of divergence between species is unclear from the sequence in a cladogram.* ° *Explain how* ***phenetics*** *classifies species entirely on the basis of measurable similarities and differences with no attempt to sort homology from analogy.* ° *Describe how, using computers, phenetic studies can compare large numbers of traits simultaneously.* ° *Explain that when trying to balance evidence from cladistics and phenetics, subjective judgements affect the final decision of taxonomic placement.* ***Skills Focus:*** infer Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • **Cladistic Activity** Have students study examples of cladograms and create new ones to explore the connection between shared characteristics and sequence of evolutionary change. CA Sci. Framework, p 243 • CA Bio, Quick Lab, p. 453, "How is a Cladogram Constructed?" OES: pending PT: pending	**CA Bio**, Ch 18:2, 33:1 ***Supplemental Resources:*** • **UC Berkley Introduction to Cladistics** http://www.ucmp.berkeley.edu/clad/clad1.html • **American Museum of Natural History: Understanding Cladistics** http://www.amnh.org/exhibitions/Fossil_Halls/cladistics.html • **Origins of Systematics: Carl Linnaeus** http://www.ucmp.berkeley.edu/history/linnaeus.html ***Key Vocabulary:*** systematics, cladistics, cladogram, phenetics, embryology, taxonomy	2 Days (1½ Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time

… how several independent molecular clocks, calibrated against each other and combined with evidence from the fossil record, can help to estimate how long ago various groups of organisms diverged evolutionarily from one another. ***(8g*)***	• *Explain how molecular clocks are used to establish phylogenetic sequences and the relative dates of phylogenetic branching.*
	  ◦ *Explain how proteins that are similar across different taxonomic groups, and the genes that produce them, are assumed to evolve at relatively constant rates.*
	  ◦ *Explain that since rates of change are assumed to be constant, the number of amino acid or nucleotide substitutions provides an estimate of how long it took to make the changes.*
	• *Explain that, while molecular clocks and data from the fossil record generally agree, the degree of molecular change is considered more reliable for determining evolutionary sequencing and branching than comparing outward morphology.*
	• *Describe how the dates of phylogenetic branching can be estimated for gaps in the fossil record by calibrating molecular change against the timeline for the observed fossil record.*
	Skills Focus:
	analyze, infer
	Formulate explanations by using logic and evidence. **(I&E 1.d)**
		Key Assignments:
		- none -
		Suggested:
		OES: pending
		PT: pending
			CA Bio, Ch 18:2
			Supplemental Resources:
			• **Molecular Clock Activity** http://www.pbs.org/wgbh/evolution/library/05/1/pdf/l_051_06.pdf
			Key Vocabulary:
			phylogenetic tree
			evolutionary systems
			convergent evolution
			analogous
			cladistics
			derived traits
				2 Days (1½ Blocks)

Physiology (Homeostasis) ***10% CST***

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.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how the complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide. **(9a)** [CST, LS10]	• Define homeostasis as a complex and dynamic equilibrium by which the body responds to changing demands while maintaining a constant internal environment. • Describe the purpose of the digestive system as removing nutrients from food and delivering them to the circulatory system. • Describe how the lungs and circulatory system work together. ° Explain how the alveoli of the lungs move O_2 from air to the circulatory system. ° Explain that, among other functions, the circulatory system delivers glucose and O_2 molecules by capillaries to each cell of the body where cellular respiration occurs. ° Describe the process of cellular respiration as oxidizing the 6-carbon glucose molecules into CO_2 and H_2O molecules (the same reaction as combustion, only slower), and storing the released energy in a chemical bond within ATP molecules. (See also standard 1g.) ° Explain how the gas exchange process that brought O_2 to the cells works in reverse to carry the CO_2 out of the cells to be released into the alveoli of the lungs and exhaled. • Explain how when amino acids from a protein are used for energy, they are chemically converted (deaminated) by the liver producing toxic ammonia, which is converted to urea and excreted by the kidneys. ° Explain that all these chemicals are transported by the circulatory system. ° Explain that various organs detect and remove specific chemicals from the circulatory system. ***Skills Focus:*** observe, compare, classify Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** • **Analogy Project** (possible) [See description on p. 50, top of Projects section.] ***Suggested:*** OES: pending PT: pending	**CA Bio**, Ch 32:1, 33:3 ***Supplemental Resources:*** • CA Bio, Quick Lab, p. 861, "How does water affect nitrogen excretion?" ***Key Vocabulary:*** homeostasis, alveoli, ATP, deaminated, glucose, glycogen	4 Days (2½ Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how the nervous system mediates communication between different parts of the body and the body's interactions with the environment. **(9b)** [CST, LS10]	• Explain how an individual becomes aware of the environment through sense organs and other body receptors (through touch, taste, and smell and by collecting information about temperature, light, and sound). • Examine and describe various ways the body constantly responds to external stimuli through reflex arcs (e.g., pupils adjusting to light, blood circulation responding to temperature). • Explain how hormones work in conjunction with the nervous system. ° Describe how insulin released by the pancreas into the blood regulates the uptake of glucose by muscle cells as controlled by the nervous system. ° Explain how the hypothalamus of the brain controls the pituitary master gland to produce human growth hormone, and many other specialized hormones (such as FSH, LH, TSH, and ACTH) as needed by the body. ° **(See also Standard 9i*.)** ***Skills Focus:*** classify, describe Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • CA Bio, Lab Manual (A), p. 249, Observing Nervous Responses OES: pending PT: pending	**CA Bio**, Ch 35:2-3, 37:1,3, and 39:2 ***Supplemental Resources:*** • CA Bio, Quick Lab, p. 903, "How do you respond to an external stimulus?" • **Peripheral Nervous System** http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/P/PNS.html • **BBC Reflex Arc** http://www.bbc.co.uk/schools/gcsebitesize/science/add_ocr/brain_mind/reflexactionsrev1.shtml • **The Basics of How Insulin and Glucagon Work** http://www.endocrineweb.com/insulin.html • **Hormone Regulation** http://users.rcn.com/jkimball.ma .ultranet/BiologyPages/H/Hormones.html • **Hypothalamus and the ANS** http://thalamus.wustl.edu/course /hypoANS.html ***Key Vocabulary:*** reflex arc hypothalamus pituitary gland	3 Days (2 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how feedback loops in the nervous and endocrine systems regulate conditions in the body. **(9c)** [CST]	• Define feedback loops as the means by which the nervous system uses the endocrine system to regulate body conditions. • Explain how the presence or absence of hormones in blood brought to the brain by the circulatory system will trigger an attempt by the brain to adjust endocrine activity and regulate the conditions in the body. ° Explain how the hormone leptin functions through a feedback loop. 1. Describe how leptin is released by fat cells when they become filled with storage reserves. 2. Describe how blood carries the leptin to the brain where it acts to inhibit appetite (an example of negative feedback). 3. Explain that when fat reserves decrease, the fat cells produce less leptin and the appetite center of the brain starts the hunger stimulus to activate the urge to eat. ***Skills Focus:*** research	***Key Assignments:*** - none - ***Suggested:*** • **Feedback Feedback** Research another hormone feedback loop (other than leptin) and create a poster or graphic organizer to present the findings OES: pending PT: pending	**CA Bio**, Ch 35:1, 39:1 ***Supplemental Resources:*** ***Key Vocabulary:*** endocrine system leptin	2 Days (1 Block)
… the functions of the nervous system and the role of neurons in transmitting electrochemical impulses. **(9d)** [CST]	• Explain how sodium-potassium pumps in the membrane of neurons create an electrical potential difference between the inside and the outside of the cell. • Define an action potential as a reversal of the normal electrical potential in a neuron *(from about –70 mV to around +40 mV)*. • Explain how a nerve impulse, or action potential, is generated when gated ion channels open to allow sodium ions (Na^+) to rush into the neuron, and that this impulse runs very quickly along the neuron as a chain reaction. • Explain how the sodium and potassium ion concentrations are restored by the sodium-potassium pumps, which actively transport the ions against the concentration gradient by using energy from ATP hydrolysis. • Explain how the action potential causes the release of neurotransmitter chemicals from the end of the axon, which enter the small gap (synapse) between neurons and begins an action potential in the next neuron. ***Skills Focus:*** sequence, describe, hypothesize, diagram	***Key Assignments:*** - none - ***Suggested:*** • **Impulse Shopping** Have students create a sequential storyboard illustrating the steps of electrochemical impulse transmission. OES: pending PT: pending	**CA Bio**, Ch 35:2 ***Supplemental Resources:*** • **Action Potential Animations** http://outreach.mcb.harvard.edu/animations/actionpotential.swf ***Key Vocabulary:*** electrochemical axon hydrolysis synapse neurons neurotransmitter	3 Days (2 Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response. **(9e)** [CST]	• Diagram a neuron showing the direction of impulses from dendrite to cell body to axon. • Explain and diagram how impulses travel from sensory neurons to interneurons to motor neurons in a reflex action. • Explain how similar pathways lead to the brain where sensations become consciously experienced and conscious actions can be taken. • Identify and differentiate gray matter and white matter in the central nervous system. ***Skills Focus:*** diagram, describe, sequence, identify	***Key Assignments:*** - none - ***Suggested:*** • Diagram the path from dendrite to reflex action. OES: pending PT: pending	**CA Bio**, Ch 35:2-4, 36:2 ***Supplemental Resources:*** ***Key Vocabulary:*** dendrite motor neurons interneurons	1 Day (½ Block)
… the individual functions and sites of secretion of digestive enzymes (amylases, proteases, nucleases, lipases), stomach acid, and bile salts. ***(9f*)***	• *Explain that digestion requires secretions of enzymes to be mixed with food as it passes through the body.* ° *Describe how salivary glands and the pancreas secrete amylase, an enzyme that breaks starch down into sugar.* ° *Describe how stomach acid and gastric enzymes begin the breakdown of proteins in food.* ° *Explain that intestinal and pancreatic secretions continue to break down proteins as they pass beyond the stomach.* ° *Describe how the pancreas also secretes lipase enzymes that break down fat molecules into free fatty acids, diglycerides, and monoglycerides.* ° *Describe how bile secreted by the liver assists digestion by emulsifying fats and facilitating the digestion of lipids.* ***Skills Focus:*** classify, diagram, relate, generalize	***Key Assignments:*** - none - ***Suggested:*** • **Digestive Tract Diagram** Diagram the digestive tract, labeling important points of secretion and tracing the pathways from digestion of starches, proteins, and other foods. CA Sci. Framework, p 246 OES: pending PT: pending	**CA Bio**, Ch 38:2 ***Supplemental Resources:*** • CA Bio, Design an Experiment, p. 990-991, Investigating the Effects of Enzymes on Food Molecules ***Key Vocabulary:*** enzymes nephron amylase diglycerides proteases monoglycerides nucleases bile lipases emulsify kidney glucose balance	2 Days (1 Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the homeostatic role of the kidneys in the removal of nitrogenous wastes and the role of the liver in blood detoxification and glucose balance. ***(9g*)***	• *Outline the role of the kidney nephron in the formation of urine.* ° *Explain how the microscopic nephrons within the kidney filter out body wastes, regulate water, and stabilize electrolyte levels in the blood.* • *Explain the role of the liver in glucose balance and blood detoxification.* ° *Explain how the liver regulates blood glucose by converting it to glycogen (glucogenesis) for storage, and breaking down the glycogen back to glucose (glycogenolysis) as needed for energy.* ° *Explain how the liver removes toxins from the blood, storing them, and excreting them into the bile.* ***Skills Focus:*** classify, describe, compare	***Key Assignments:*** - none - ***Suggested:*** • CA Bio, Lab Manual (A), p. 267, Simulating Urinalysis OES: pending PT: pending	**Bio:P&E**, Ch 32:1, 33:3, and 38:3 ***Supplemental Resources:*** ***Key Vocabulary:*** nitrogenous waste detoxification glycogenolysis glucogenesis electrolyte	2 Days (1 Block)
… the cellular and molecular basis of muscle contraction, including the roles of actin, myosin, Ca^{2+}, and ATP. ***(9h*)***	• *Diagram the basic structure of an individual muscle segment, a sarcomere, bounded by Z lines.* • *Explain how the globular heads of myosin molecules bind to actin molecules, and by rotating, pull on the actin so that the sarcomere is shortened.* • *Explain that muscle contraction requires Ca^{2+} ions which bind to the actin so that the sites where the myosin heads attach are exposed.* • *Explain that ATP is needed for the myosin to let go of the actin, so that it can either bind a new spot further along on the actin and contract the muscle more, or allow the muscle to relax.* ***Skills Focus:*** observe, relate, identify, describe	***Key Assignments:*** - none - ***Suggested:*** OES: pending PT: pending	**CA Bio**, Ch 36:2 ***Supplemental Resources:*** • **Muscle Structure** http://www.brookscole.com/chemistry_d/templates/student_resources/shared_resources/animations/muscles/muscles.html • **Sliding Filament Model of Muscle Contraction** http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter10/animation__action_potentials_and_muscle_contraction.html • **Contraction in Action Activity** http://www.accessexcellence.org/AE/AEC/AEF/1996/lazaroff_contraction.php ***Key Vocabulary:*** actin sacromere myosin	2 Days (1 Block)
… how hormones (including digestive, reproductive, osmoregulatory) provide internal feedback mechanisms for homeostasis at the cellular level and in whole organisms. ***(9i*)***	• *Explain that hormones act as chemical messengers, affecting activity in neighboring cells or other target organs* • *Explain that the movement of hormones can be traced from their point of origin to the target site where they have influence.* • *Explain that hormones affect and are affected by levels of other chemicals in the body, creating feedback loops that promote homeostasis.* ***Skills Focus:*** summarize, generalize, relate	***Key Assignments:*** - none - ***Suggested:*** OES: pending PT: pending	**CA Bio**, Ch 37:1, 39:1-3 ***Supplemental Resources:*** • **Homeostasis and Hormones** http://www.bbc.co.uk/schools/gcsebitesize/science/ocr_gateway/ourselves/5_staying_in_balance1.shtml • **Sugar Homeostasis** http://www.biology-online.org/4/3_blood_sugar.htm ***Key Vocabulary:*** osmoregulatory	2 Days (1 Block)

Physiology (Infection and Immunity) ***6.7% CST***

10. Organisms have a variety of mechanisms to combat disease.

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… the role of the skin in providing nonspecific defenses against infection. **(10a)** [CST]	• Explain that the skin serves as a physical barrier to the enormous number of potentially disease causing microorganisms in the environment. • Explain the potential dangers of cuts and abrasions that compromise the skin's ability to serve as a barrier. ***Skills Focus:*** describe, analyze	***Key Assignments:*** • **Analogy Project** (possible) [See description on p. 50, top of Projects section.] ***Suggested:*** OES: pending PT: pending	**CA Bio**, Ch 36:3, 40:2 ***Supplemental Resources:*** • **Merck Manual on the Epidermis** http://www.merck.com/mmhe/sec18/ch201/ch201b.html • **Skin Biology and Structure** http://www.mydr.com.au/skin-hair/skin-biology-and-structure ***Key Vocabulary:*** inflammatory response temperature response histamine mucous	1 Day (½ Block)
… the role of antibodies in the body's response to infection. **(10b)** [CST, LS10]	• Define antigens as substances that are foreign to the body. • Give specific examples of antigens, such as the surface proteins of a flu virus, which are different in shape and structure from human proteins. • Explain that when the immune system recognizes antigens, it produces proteins called antibodies that specifically bind to the antigen that was found. • Explain that antibodies either inactivate pathogens directly or signal other immune cells to attack the pathogen. ***Skills Focus:*** analyze, research	***Key Assignments:*** - none - ***Suggested:*** OES: pending PT: pending	**CA Bio**, Ch 40:2 ***Supplemental Resources:*** • **Antibody and Antigen** http://www.scienceclarified.com/AI-As/Antibody-and-Antigen.html ***Key Vocabulary:*** antigen pathogen antibody	2 Days (1 Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… how vaccination protects an individual from infectious diseases. **(10c)** [CST, LS10]	• Explain that a problem with the immune system is that it takes several weeks to develop immunity to a new antigen. • Explain that vaccinations avoid the problem of delay by giving the body contact with the disease antigens in advance. • Recall that vaccines for a given disease usually contain killed pathogens for that disease or a purified surface protein from the pathogen. • Explain how the antigens in vaccines do not cause disease, but stimulate the body to generate antibodies to oppose the pathogen. • Explain that the immune system of a body that has been exposed to a vaccine responds quickly, because it "remembers" having been exposed to the antigen. ***Skills Focus:*** research Use critical thinking skills to make informed decisions and solve problems. **(FS 5.3)** Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. **(I&E 1.m)**	***Key Assignments:*** - none - ***Suggested:*** • **Personal Vaccination Record** Students find their own vaccination records and research the purpose and makeup of one of the vaccinations. CA Sci. Framework, p 248 • **History of Vaccines** Students research the history of vaccine development from the 1700s through the twentieth century and up to the most current applications. CA Sci. Framework, p 248 OES: pending PT: pending	**CA Bio**, Ch 19:3, 40:2 ***Supplemental Resources:*** ***Key Vocabulary:*** immunity vaccination vaccine	2 Days (1 Block)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… 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. **(10d)** [CST, LS10]	• Define viruses as the simplest form of a genetic entity, containing genetic material (either DNA or RNA) surrounded by protein, but have no ribosomes or other organelles. • Define bacteria as the simplest organisms with a full cellular structure. • Compare and contrast the growth and reproduction requirements of viruses and bacteria. ° Explain that viruses are incapable of metabolism or reproduction outside of the cells of other living organisms. ° *Explain that bacteria are self-contained organisms that live in a variety of environments and can reproduce sexually or asexually. (LBUSD)* ° Explain that viruses can be benign or cause harm by destroying or altering host cell structures from within. ° Explain how bacteria can be benign or *helpful (LBUSD)*, or can cause harm by damaging host cells or releasing toxins. • Compare the body's defense mechanisms against viral and bacterial infections. ° Explain that the body recognizes the surface proteins of viruses as antigens and produces antibodies to neutralize the viruses. ° Explain that the body recognizes the surface proteins and toxins of bacteria as antigens and produces antibodies to neutralize them. • Explain the differences in effective treatments for viral and bacterial infections. ° Define antiseptics as chemicals that oxidize or otherwise kill infectious agents. ° Explain how antiseptics can be used to prevent infections or even treat surface infections. ° Define antibiotics as substances that can treat bacterial infections by destroying or interfering with the growth or physiology of the bacterial cell wall, or by inhibiting the synthesis of bacterial DNA, RNA, or proteins. ° Explain that antibiotics are ineffective against viruses. ° Explain the dangers of developing antibiotic-resistant bacteria through long-standing over-application of antibiotics. ***Skills Focus:*** compare and contrast Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. **(I&E 1.m)**	***Key Assignments:*** - none - ***Suggested:*** • **Research on Infections** Students research infections caused by protists (malaria, amoebic dysentery), bacteria (blood poisoning, botulism, food poisoning, tuberculosis), and viruses (rabies, colds, influenza, AIDS), or specific infections currently being discussed in the media. Students should address growth and reproduction requirements, and the effectiveness of the bodies defenses and medical treatments. CA Sci. Framework, p 249 • **Antibiotic Disc Activity** Students can use commercially available antibiotic discs to show the inhibition of bacterial growth on agar plates. CA Sci. Framework, p 249 OES: pending PT: pending	**CA Bio**, Ch 19:2-3, 40:2 ***Supplemental Resources:*** • **Viruses and Bacteria** http://www.netdoctor.co.uk/health_advice/facts/virusbacteria.htm ***Key Vocabulary:*** capsid, envelope, bacteriophage, antibiotic resistance, antibiotic, antiseptic, toxin	4 Days (2½ Blocks)

Content Standards (CONTENT) "Students know…"	Content Standards (SKILL) "Students are able to …"	Perf. Std. Measures How students DEMONSTRATE KNOWLEDGE and SKILL.	Instructional Support	Appx Time
… why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections of microorganisms that are usually benign. **(10e)** [CST]	• Explain that the human immunodeficiency virus (HIV) infects and destroys key cells of the immune system before those cells can recognize and attack the virus. • Explain how an immune system can be compromised so that it becomes either unable to recognize a dangerous antigen or incapable of mounting an appropriate defense. ***Skills Focus:*** analyze Understand the importance of accountability and responsibility in fulfilling personal, community, and workplace roles. **(FS 7.2)** Formulate explanations by using logic and evidence. **(I&E 1.d)**	***Key Assignments:*** - none - ***Suggested:*** • Discovery Video, "Understanding Viruses", available at SMRC OES: pending PT: pending	**CA Bio**, Ch 40:3 ***Supplemental Resources:*** • **Center for Disease Control** http://www.cdc.gov/hiv/topics/basic/index.htm ***Key Vocabulary:*** AIDS HIV compromised opportunistic infection	1 Day (½ Block)
… the roles of phagocytes, B-lymphocytes, and T-lymphocytes in the immune system. ***(10f*)***	• *Identify and describe phagocytes (or macrophages) as cells that move, amoeba-like, through the circulatory system, consuming waste and foreign material, including some bacteria and viruses.* • *Identify and describe lymphocytes as a class of white blood cells that originate in the bone marrow during embryonic life.* ° *Describe B-lymphocytes (or B cells) as cells that mature in the bone marrow and give rise to antibody-producing plasma cells.* ° *Recall that each mature B-lymphocyte can give rise to only one antibody, which itself is specific for a single foreign antigen.* ° *Describe T-lymphocytes (or T cells) as cells that mature in the thymus gland and give rise to cytotoxic ("cell killing") and "helper" T-lymphocytes.* ° *Recall that cytotoxic T cells identify and destroy cells infected with intracellular pathogens, which cannot be reached by antbodies.* ° *Recall that helper T cells assist by activating the plasma cells to produce antibodies (humoral immune response) and cytotoxic T cells to attack infected body cells (cellular immune response).* ***Skills Focus:*** describe, model	***Key Assignments:*** - none - ***Suggested:*** • **Non-diplomatic Immunity** Students design and perform skits or create story analogies to humoral and cellular immune responses to infection. • CA Bio, Quick Lab, p. 1041, "How does cell-mediated immunity work?" OES: pending PT: pending	**CA Bio**, Ch 37:2, 40:2 ***Supplemental Resources:*** • **Inner Life of A Cell – Cellular Immune Response** http://multimedia.mcb.harvard.edu/anim_innerlife.html ***Key Vocabulary:*** lymphocytes cytotoxic B-cells marrow T-cells humoral plasma cells	2 Days (1 Block)

KEY ASSIGNMENTS / ASSESSMENTS:

Key Laboratory Activities	Lab activities are selected to illustrate the key concepts of biology. Student lab reports for Key Assignment labs are based on experimental design where students investigate a testable question. Students either generate or follow procedures to collect data. They then create graphs and/or diagrams to analyze that data in order to answer the posed question. Student comprehension of the underlying concepts and processes are verified by response to written and oral questions, using key scientific vocabulary. After this, students write a summary of critical observations and conclusions. *(See the specific Key Laboratory descriptions on the next page.)*
Major Written Assignments	Students complete one or two research papers of five paragraph minimum length. *[Writing associated with projects listed below may replace the second research paper.]* This paper requires students to gather information from at least five different sources representing at least three different types of resources. The paper connects content of biology class to practical applications. Possible topics include: • Form vs. Function Essay: (can address organelle [1a,e,f,g,i*,j*], organ system [9a-i], organism [7a-d, 8a-d], or symbiotic relationship [6a-c,e,f] level) • Genetics Essay (genetic disorders [3a] or biotechnology applications [5c-e]) • Evolution Essay (connecting how populations and their environments have evolved [7d, 8a,c,d,g*], speculating about future evolution [8e,f], or analyzing evidence for evolution [8d-g*]) • "Do Your Cells Belong to You?" (ethical analysis [5c-e*]) • "Are Viruses Alive?" (persuasive writing – defending a point of view [1c, 5c, 10d])
Performance-Based Projects	✓ Analogy Project: Students create a project that illustrates both structures and functions working together toward a common purpose. Possible topics for this include cell organelles [1a,e,f,g,i*,j*], protein synthesis [4a-c,e,f*], physiology of organ systems[9a-i], or immune response[10a-f*]. ✓ Content Project with Service Learning: Students also complete a project requiring data collection, analysis, and interpretation of data using graphs and simple statistics. This project also includes five hours toward the service learning graduation requirement. *(Service learning is an instructional strategy that connects meaningful service experiences in the community with academic learning, personal growth, and civic responsibility. Service learning enhances what is taught in the course by extending learning beyond the classroom and providing opportunities for students to use newly acquired skills and knowledge in real-life situations in their own communities. The purpose of Service learning is to make coursework more relevant.)* For the service learning component, students can become involved with in-situ habitat studies/development, local environmental or ecological projects, cross-level teaching, public advocacy, or community outreach. Possible topics can range from ecology to physiology. Community organizations and businesses are often good resources for students, such as the El Dorado Nature Center, LB or Cabrillo Aquariums, Zoos or Animal Parks, hospitals, city government offices, or the Port of Long Beach. When presenting this project, students will include evidence of their service learning and a brief reflection on the connection to the class content and how the experience has affected them personally. • Students also create smaller individual and group oral presentations with PowerPoint or other presentation software that is submitted electronically. • Biology students also contribute to cross-curricular projects developed by and for their Small Learning Community. Some of these may include service learning that can take the place of that portion of the Content Project.

Unit Tests	Unit tests include selected response questions based primarily on conceptual understanding (including data and graph interpretation), not merely factual recall. Unit tests also include short answer free-response or essay questions connecting key concepts. For example, students may answer a question about photosynthesis and aerobic respiration which asks how the two processes are connected. As applicable, teachers also include skill-based practical exams. (i.e., use of measuring devices, microscope use, and dissection involving anatomical identification with function and phylogenic analysis.)
Comprehensive Semester Finals	Biology has comprehensive semester finals. The second semester final covers content from the entire year.

KEY LABORATORY ACTIVITIES (Key Labs):

A minimum of 30 laboratories is recommended for this course. Our district recommends that approximately 40% of instructional time be devoted to hands-on laboratory and project-based activities. Core experiences for this course include detailed laboratories with complete write-ups on the following topics:

Osmosis and Selective Permeability (1a)

Students prepare, observe, and explain osmotic effects seen in different solutions. This may be done using dialysis tubing sugar, starch, and colored water, or less expensively, using grapes, potatoes, or carrots. Students draw conclusions about what they observe, justifying their conclusions based on concepts they have learned about osmosis, selective permeability, and the structural properties of the macromolecules present. They then make predictions about processes at the cell membrane and the need for something more than just osmosis.

Enzyme Action (1b)

Students measure the effects of concentration, temperature, and/or pH on enzyme activity using potato, liver, or yeast catalase and H_2O_2. They then make predictions about the reaction rate of the enzyme and discuss the role of enzymes in the stomach and intestinal tract with respect to pH.

Photosynthesis / Cellular Respiration (1f,g 6d)

Students measure O_2 and CO_2 production to illustrate how they cycle through photosynthesis and respiration. This can be done in closed containers using elodea, snails, and aquarium water with bromthymol blue. In doing so, students recognize that both photosynthesis and respiration occur in plants (and other photosynthetic organisms) depending on light intensity and time of day. A primary purpose of this lab is to address the common misconception that plants only perform photosynthesis, and should therefore be used before direct instruction. Possible extension activities include investigating fermentation and chromatography to separate pigments.

Macromolecules (1h)

Students test for the presence of lipids, carbohydrates, and proteins. For instance, enzymatic breakdown of starch into its glucose subunits can be illustrated using amylase from saliva or bean juice. Students also build models of macromolecules to illustrate the evidence of smaller precursors within a larger molecule. From the gross structures of these models, students can also determine if a molecule is polar and explain how polarity determines the hydrophilic nature of carbohydrates versus hydrophobic nature of fats. This can be tied back to cell membrane structure. Students may also use other 2-D and 3-D representations and mnemonics (i.e., "CHO, CHONS, CHOPN") to help identify the biologically significant macromolecule structures.

Genetic Probability (3a)

Students perform a lab activity that demonstrates that 1 allele/trait is inherited from each parent and the chance of inheriting either allele is equal as demonstrated by a Punnett square. Students also explain that the combination of alleles create different genotypes and phenotypes depending on dominance. These concepts can be seen using corn genetics, fruit fly genetics, or "baby lab." Additional lab activities are also recommended that demonstrate X-linkage and incomplete dominance.

Protein Synthesis (4a-c)

Students engage in an activity that transcribes a segment of DNA into RNA and then translate the RNA into a sequence of amino acids. The Quick Lab on p. 303, "How does a cell interpret DNA" can be used to illustrate how amino acids produce polypeptides which create traits. It can also be modified to illustrate how mutations may alter the amino acid sequence, and therefore traits.

DNA Isolation (5a)

In conjunction with studies of the structure of DNA molecules, students extract DNA from strawberries (octapliod) or other types of cells, closely analyzing each lab step to reinforce cell structure. Students illustrate and/or explain how each lab step affects cell structure. Students also use their understanding of the DNA/protein structure of chromosomes to propose explanations for the difference in the appearance of cells in interphase versus other stages of mitosis, and also the DNA they have extracted.

Ecology (6a-e)

Students record observations of an ecosystem. This can be done in self-contained, classroom vessel ("Bottle Biosphere") or outside on campus, at a park, or at home. Students need to specifically identify organisms and their ecological roles, along with what abiotic factors are important to the ecosystem.

Natural Selection (7a,d)

Students perform or create an activity that illustrates how natural selection can change a population when the environment changes. Common activities that accomplish this include "Beak of the Finch" and "O Deer." Students predict how traits within a population will change given an environmental change describing how variations promote survival of a species. Students also predict how this fuels future evolutionary change.

Homozygous Alleles (7b)

Students create models to explore and graph how alleles, even lethal alleles, are carried from generation to generation. They will use their data to explain why expressed traits (phenotypes) can often skip generations.

INSTRUCTIONAL METHOD AND/OR STRATEGIES:
A variety of instructional strategies will be utilized to accommodate all learning styles:

Biology-specific Methods:

1. lectures, videos, and demonstrations
2. readings from texts, journals, and internet sites
3. laboratory experiments and detailed written laboratory reports that emphasize experimental analysis
4. pre- and post-lab discussions
5. student presentations
6. field trips and guest speakers
7. research projects and written reports

Lesson Design & Delivery: Teachers will incorporate these components of lesson design during direct instruction and inquiry activities. The order of components is flexible, depending on the teacher's vision for the individual lesson. For instance, the objective and purpose, while present in the teacher's lesson plan, are not made known to the students at the beginning of an inquiry lesson.

Essential **E**lements of **E**ffective **I**nstruction Model for Lesson Design Using Task Analysis	Anticipatory Set Objective Standard Reference Purpose Input Modeling Check for Understanding Guided Practice Closure Independent Practice

Some components may occur once in a lesson, but others will recur many times. Checking for understanding occurs continually; input, modeling, guided practice and closure may occur several times. There may even be more than one anticipatory set when more than one content piece is introduced.

Active Participation: Teachers will incorporate the principles of active participation and specific strategies to ensure consistent, simultaneous involvement of the minds of all learners in the classroom. Teachers should include both covert and overt active participation strategies, incorporating cooperative learning structures and brain research. Some of the possible active participation strategies include:

COVERT	OVERT (Oral)	OVERT (Written)	OVERT (Gestures)
• Recall	• Think (Write)/Pair/Share	• Restate in Notes	• Hand Signals
• Imagine	• Idea Wave	• Response Boards	• Model with Hand Motions
• Observe	• Choral Response	• Graphic Organizers	• Stand up/ Sit down
• Consider	• Give One, Get One	• Folded Paper	• Point to Examples
	• Socratic Seminar	• Ticket Out of Class	

Diverse learning styles may be addressed by implementing combinations of the following:

Significant, Proven Strategies for ALL Science Students

- ❑ Hands-On Lab's
- ❑ Inquiry Activities
- ❑ Short/Long-term projects
- ❑ Student Presentations
- ❑ Peer Teaching
- ❑ Summarization
- ❑ Essential Questions
- ❑ Thematic Units
- ❑ Field Experiences
- ❑ Current Events
- ❑ Career Choices
- ❑ Guest Speakers

Reading Strategies in Science

- ❑ Vocabulary Development (including conceptual and non-linguistic components)
- ❑ Anticipation Guides
- ❑ Pre-teaching
- ❑ Pre-reading
- ❑ Text Structures
- ❑ Trail Markers
- ❑ Reciprocal Teaching
- ❑ Functional Text

SDAIE Strategies for English Learners

- ❑ Lower the Affective Filter (including Processing Time)
- ❑ Tapping/Building Prior Knowledge (Graphic Organizers, Schema)
- ❑ Acquisition Levels
- ❑ Language Sensitivity
- ❑ Grouping Strategies
- ❑ Home/School Connection (including Cultural Aspects)
- ❑ Multiple Intelligences
- ❑ Adapt the Text
- ❑ Manipulatives & Visuals

Strategies for Students with Disabilities

- ❑ IEP Accommodations (refer to student's IEP document or IEP summary sheet)
- ❑ Curricular Adaptations (e.g., quantity, input, participation, time, level of difficulty, level of support, output, substitute curriculum, alternate goals)
- ❑ Think Alouds
- ❑ Small Group Instruction / Learning Centers
- ❑ Manipulatives & Visuals
- ❑ Peer Assisted Learning

Differentiation for Advanced Learners

- ❑ Curriculum Compacting
- ❑ Depth and Complexity
- ❑ Flexible Grouping
- ❑ Acceleration
- ❑ Tiered Assignments
- ❑ Independent Study

Please note that these strategies often overlap and should not be limited to specifically defined courses or student populations.

TEXTBOOKS:

Basic Textbook: ☑ Read in entirety ☐ Excerpts used California Biology, Miller and Levine, Pearson – Prentice Hall, © 2007

SUPPLEMENTAL INSTRUCTIONAL MATERIALS:

In addition to the basic text, a variety of instructional tools will be used to meet the needs of all students

Safety Equipment:	goggles, lab aprons, fire extinguisher, eye wash station
Measuring Devices:	decigram balances, mm rulers, triple beam balances, volumetric graduated cylinders
Other Laboratory Equip:	microscopes, dissection equipment, Bunsen burners, petri dishes, pipettes, electrophoresis equipment
Laboratory Supplies:	chemical reagents, filter paper, chromatography paper
Other:	Computer-based software and hardware, including computer labs, internet access, word processing and presentation programs, and student tutorials/practice.

❖ Many items – including preserved specimens, anatomical models, bioramas, hot plates, posters, and videos – are available through Science/Math Resource Center (SMRC).

RESOURCES:

Documents

- Science Framework: ..... http://www.cde.ca.gov/ci/cr/cf/documents/scienceframework.pdf
- CST / NCLB Test Blueprints: ..... http://www.cde.ca.gov/ta/tg/sr/blueprints.asp
- CST Reference Sheets: ..... http://www.cde.ca.gov/ta/tg/sr/cstsciref.asp
- National Science Standards: ..... http://www.nap.edu/openbook.php?isbn=0309053269
- Science Safety Handbook for CA Public Schools (1999) can be ordered from the CDE at .. http://www.cde.ca.gov/pd/ca/sc/documents/scisafebk.pdf
- LBUSD Approved Chemicals List, Chemical Hygiene Plan, and Science Fair Resources: at LBUSD website, Science/Teacher Resources

ASSESSMENT METHODS AND/OR TOOLS:

Student achievement in this course will be measured using multiple assessment tools including but not limited to:

Suggested Evaluation Tools:

Source	Diagnostic	Formative	Summative
District Level Assessments		Constructed Response Questions (OES)	Biology End of Course Exam
Pearson - Prentice Hall: Biology-CA	Inquiry Activity	Progress Monitoring Assessments Reading & Study Workbook Section Assessments Reading Strategies: Graphic Organizers	Chapter Assessments Lab Analysis and Conclusions
Teacher Developed Assessments	pretest / pre-quiz / brainstorming homework assessment peer evaluation notebook organization and note-taking skills	lab-based performance tasks cooperative group assessment written reports with oral presentations open-ended written assessment	portfolios research projects rubric scoring long-term projects single-response testing

PERFORMANCE STANDARDS:

Defines how good is good enough on which measures to demonstrate achievement of content standards.

State Performance Standards:

The California State Board of Education has identified the following performance levels for the California Standards Test (CST) in Biology/Life Sciences. The objective of Long Beach Unified School District is to have all students achieve at or above the Proficient Performance Standard (Level). The table below indicates the number correct, the estimated percent correct (based on 2009 data) and the Reported Scaled Score (SS) on the Content Standards Test.

Far Below Basic	Below Basic	Basic	Proficient	Advanced Proficient
SS 150 – 275	**SS 276 – 299**	**SS 300 – 349**	**SS 350 – 393**	**SS 394 – 600**
0-18 Correct	**19-24 Correct**	**25-38 Correct**	**39-47 Correct**	**48-60 Correct**
Less than 32%	**32% - 40%**	**42% - 63%**	**65% - 78%**	**80% - 100%**

District Performance Standards:

The Long Beach Unified School District has common assessments and key assignments that are required for Biology. The Performance Standard Criteria for district-wide and classroom setting are shown in the table below.

	Not Proficient	Partial Proficient	Proficient	Advanced Proficient
End-Of-Course Exam	**Less than 60%**	**60% - 69%**	**70% - 84%**	**85% - 100%**
Constructed Response	(6 pt rubric) **1-2** (4 pt rubric) **1**	(6 pt rubric) **3** (4 pt rubric) **2**	(6 pt rubric) **4** (4 pt rubric) **3**	(6 pt rubric) **5-6** (4 pt rubric) **4**

Classroom Performance Standards:

The objective of instruction is to help all students achieve at or above the Proficient Level and receive a C or better in the course. Performance level is determined by the average of the assessments or assignments.

	Not Proficient	Partial Proficient	Proficient	Advanced Proficient
Graded Student Work	**Rubric Avg. of 1 or less than 60%**	**Rubric Avg. of 2 or 60% - 69%**	**Rubric Avg. of 3 or 70% - 84%**	**Rubric Avg. of 4 or 85% - 100%**
Labs, Written Assignments, Perf. Tasks, and Projects	(6 pt rubric) **1-2** (4 pt rubric) **1**	(6 pt rubric) **3** (4 pt rubric) **2**	(6 pt rubric) **4** (4 pt rubric) **3**	(6 pt rubric) **5-6** (4 pt rubric) **4**
Teacher/Dept-developed Tests and Exams	**Less than 60%**	**60% - 69%**	**70% - 84%**	**85% - 100%**

SUGGESTED GRADE WEIGHTING:

(with some possible examples)

1. Assessment ~30%

- objective tests including comprehensive finals
- lab practica / performance tasks (rubric scored)
- constructed response questions (rubric scored)
- portfolios
- student self-evaluations

2. Homework not more than 10%

- discovery assignments
- assignments reinforcing class lesson
- essays
- organization
- research

3. Labs ~25%

- lab reports (may be rubric scored)
- active engagement in group work

4. Projects ~25%

- research-based written assignments and projects
- service learning projects
- inquiry projects
- science fair projects

5. Classwork ~10%

- note taking skills
- organization skills
- oral presentations
- graded individual and group work

STANDARD GRADING SCALE:

Advanced Proficient	A	90 – 100%
	B	80 – 89%
Proficient	C	70 – 79%
Partial Proficient	D	60 – 69%
Not Proficient	F	0 – 59%

Submitted by: Eric Brundin
School: Science Office
Date: 01/11
Revised Board Date: 2/15/11