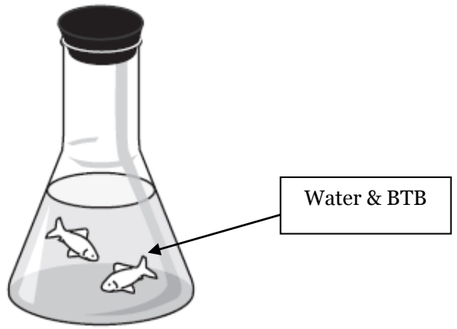
Subject Area Standards Assessment [SASA] Guide

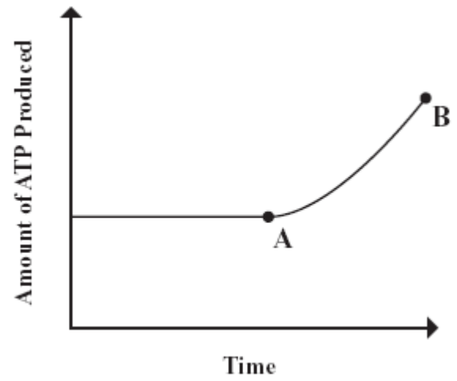
COURSE: ***BIOLOGY*** • UNIT:1 • TOPIC: ***INTRODUCTON TO BIOLOGY/CELL BIOLOGY***

California Content Standard	Clarification [Science Frameworks]	Key Ideas & Vocabulary**	Sample Test Item
1a. Students know cells are enclosed within semi permeable membranes that regulate their interaction with their surroundings	The plasma membrane consists of two layers of lipid molecules organized with the polar (globular) heads of the molecules forming the outside of the membrane and the non-polar (straight) tails forming the interior of the membrane. Protein molecules embedded within the membrane move about relative to one another in a fluid fashion. Because of its dynamic nature the membrane is sometimes referred to as the fluid mosaic model of membrane structure. Cell membranes have three major ways of taking in or of regulating the passage of materials into and out of the cell: simple diffusion, carrier-facilitated diffusion, and active transport. Osmosis of water is a form of diffusion. Simple diffusion and carrier-facilitated diffusion do not require the expenditure of chemical bond energy, and the net movement of materials reflects a concentration gradient or a voltage gradient or both. Active transport requires free energy, in the form of either chemical bond energy or a coupled concentration gradient, and permits the net transport or "pumping" of materials against a concentration gradient.	Cell Membrane Fluid Mosaic Model Transport Proteins Phospholipid Bilayer Polar vs. Non-polar Diffusion Osmosis Voltage-gradient Concentration Gradient Active vs. Passive Transport Hypo-, Hyper-, and Isotonic Environment Carrier-facilitated diffusion	**1. Placing wilted lettuce in cold water will make it crisp again. Which statement best describes what happens to restore the lettuce to its original condition?** **A** Water left the lettuce cells by diffusion. **B** Water entered the cells of the lettuce by osmosis. **C** Osmosis caused salts to enter the lettuce cells. **D** Salts in the leaf caused water to leave the cells. From: North Carolina Testing Program [Biology Released Questions] **DOK LEVEL: 2 [Analysis]**
1b. Students know enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings.	Almost all enzymes are protein catalysts made by living organisms. Enzymes speed up favorable (spontaneous) reactions by reducing the activation energy required for the reaction, but they are not consumed in the reactions they promote. To demonstrate the action of enzymes on a substrate, the teacher can use liver homogenate or yeast as a source of the enzyme catalase and hydrogen peroxide as the substrate. The effect of various environmental factors, such as pH, temperature, and substrate concentration, on the rate of reaction can be	Catalysts Enzymes Activation Energy Denaturation Substrate Lock and Key Model	**2. Most cellular activities are processes regulated by the action of —** **F** carbohydrates **G** enzymes **H** lipids **J** polysaccharides From: Virginia 2005 Biology Released Test Questions **DOK LEVEL: 1 [Recall & Reproduction]**

	investigated. These investigations should encourage student observation, recording of qualitative and quantitative data, and graphing and interpretation of data.		
California Content Standard	**Clarification [Science Frameworks]**	**Key Ideas & Vocabulary****	**Sample Test Item**
1c. Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.	All living cells are divided into one of two groups according to their cellular structure. Prokaryotes have no membrane-bound organelles and are represented by the Kingdom Monera, which in modern nomenclature is subdivided into the Eubacteria and Archaea. Eukaryotes have a complex internal structure that allows thousands of chemical reactions to proceed simultaneously in various organelles. Viruses are not cells; they consist of only a protein coat surrounding a strand of genetic material, either RNA or DNA.	Prokaryotic vs. Eukaryotic cells Viruses Plant vs. Animal Cells Genetic Material	**3. Which two cell structures are present in plant cells but lacking in animal cells?** **M**. chloroplasts and mitochondria **N**. cell membrane and cell wall **O**. cell wall and chloroplasts **P.** nucleus and cell membrane **DOK LEVEL: 2 [Analysis]**
1e. Students know the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.	There are two types—rough and smooth—of endoplasmic reticulum (ER), both of which are systems of folded sacs and interconnected channels. Rough ER synthesizes proteins, and smooth ER modifies or detoxifies lipids. Rough ER produces new proteins, including membrane proteins. The proteins to be exported from the cell are moved to the Golgi apparatus for modification, packaged in vesicles, and transported to the plasma membrane for secretion.	Rough vs. Smooth ER Golgi apparatus Vesicles Secretion Exocytosis Vesicle formation Protein modification	**4. Which cell organelle repackages proteins into forms the cell can use, expel, or keep stored?** **F** Lysosomes **G** Mitochondria **H** Golgi bodies **J** Centrioles From: Virginia 2005 Biology Released Test Questions **DOK LEVEL: 1 [Recall & Reproduction]**
1f. Students know usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.	Photosynthesis is a complex process in which visible sunlight is converted into chemical energy in carbohydrate molecules. This process occurs within chloroplasts and specifically within the thylakoid membrane (light-dependent reaction) and the stroma (light-independent reaction). During the light-dependent reaction, water is oxidized and light energy is converted into chemical bond energy generating ATP, NADPH + H+, and oxygen gas.† During the light-independent reaction (Calvin cycle), carbon dioxide, ATP, and NADPH + H+ react, forming phosphoglyceraldehyde, which is then converted into sugars. By using a	Photosynthesis Carbohydrate [Glucose] Chloroplast Thylakoid membranes Stroma Light-dependent reactions Light-independent Reactions ATP, NADP Oxygen gas	**5. In terms of ATP production, which process results in the most stored energy?** **A** aerobic respiration **B** anaerobic respiration **C** fermentation **D** photosynthesis From: North Carolina Testing Program [Biology Released Questions] **DOK LEVEL: 2 [Analysis]**

	microscope with appropriate magnification, students can see the chloroplasts in plant cells (e.g., lettuce, onion) and photosynthetic protists (e.g., euglena). Students can prepare slides of these cells themselves, an activity that provides a good opportunity to see the necessity for well-made thin sections of specimens and for correct staining procedures. Commercially prepared slides are also available. By observing prepared cross sections of a leaf under a microscope, students can see how a leaf is organized structurally and think about the access of cells to light and carbon dioxide during photosynthesis. The production of oxygen from photosynthesis can be demonstrated and measured quantitatively with a volumeter, which can collect oxygen gas from the illuminated leaves of an aquatic plant, such as elodea. By varying the distance between the light source and the plant, teachers can demonstrate intensities of the effects of various illumination. To eliminate heat as a factor, the teacher can place a heat sink, such as a flat-sided bottle of water, between the plant and light source to absorb or dissipate unwanted heat.	PGAL Leaf structure	**14. Bromthymol blue [BTB] is a chemical indicator that turns blue to yellow as the level of CO_2 increases. What would happen over time to the experimental set up shown below?**  **A**. The solution will change from blue to yellow. **B**. The solution will change from yellow to blue. **C**. The solution will turn blue to colorless. **D**. The solution will turn yellow to colorless. **DOK LEVEL: 2 [Analysis]**

California Content Standard	Clarification [Science Frameworks]	Key Ideas & Vocabulary**	Sample Test Item
1g. Students know the role of the mitochondria in making stored chemical-bond energy available to cells by completing the breakdown of glucose to carbon dioxide.	Mitochondria consist of a matrix where three-carbon fragments originating from carbohydrates are broken down (to CO2 and water) and of the cristae where ATP is produced. Cell respiration occurs in a series of reactions in which fats, proteins, and carbohydrates, mostly glucose, are broken down to produce carbon dioxide, water, and energy. Most of the energy from cell respiration is converted into ATP, a substance that powers most cell activities.	Mitochondrion Cristae NADH Cell respiration	**6. Some cells, such as human nerve and muscle cells, contain many more mitochondria than do other cells, such as skin cells. Why do some cells have more mitochondria than others?** **A**. The cells use more energy. **B**. The cells store more nutrients. **C**. The cells break down more proteins. **D**. The cells divide more frequently. From: 2006 Massachusetts Biology Released Test Items **DOK LEVEL: 2 [Analysis]**

			12. **The graph below shows the amount of ATP produced in a cell during a period of time.**  **According to the graph, the availability of which molecule <u>must</u> have increased between points A and B?** **A**. DNA **B**. glucose **C** water **D**. salt or NaCl From: Massachusetts Biology Released Test Questions 2006 **DOK Level: 2[Analysis]**
California Content Standard	**Clarification [Science Frameworks]**	**Key Ideas & Vocabulary****	**Sample Test Item**
1h. Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.	Many of the large carbon compound molecules necessary for life (e.g., polysaccharides, nucleic acids, proteins, and lipids) are polymers of smaller monomers. Polysaccharides are composed of monosaccharides; proteins are composed of amino acids lipids are composed of fatty acids, glycerol, and other components; and nucleic acids are composed of nucleotides.	Polymers Monomers Proteins Amino acids Carbohydrates Monosaccharides Lipids Fatty acids, glycerol Nucleic acids Nucleotides	**7. Lipids and carbohydrates are important in animal cells because both —** **A** store energy **B** contain nitrogen **C** form cell walls **D** provide insulation From: Virginia 2005 Biology Released Test Questions **DOK LEVEL: 1 [Recall & Reproduction]**

Subject Area Standards Assessment [SASA] Guide

COURSE: ***BIOLOGY*** • UNIT: ***2*** • TOPIC: ***MOLECULAR GENETICS (DNA/RNA)***

California Content Standard	Clarification [Science Frameworks]	Key Ideas & Vocabulary**	Sample Test Item
4a. Students know the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.	DNA does not leave the cell nucleus, but messenger RNA (mRNA), complementary to DNA, carries encoded information from DNA to the ribosomes (transcription) in the cytoplasm. (The ribosomes translate mRNAs to make protein.) Freely floating amino acids within the cytoplasm are bonded to specific transfer RNAs (tRNAs) that then transport the amino acid to the mRNA now located on the ribosome. As a ribosome moves along the mRNA strand, each mRNA codon, or sequence of three nucleotides specifying the insertion of a particular amino acid, is paired in sequence with the anticodon of the tRNA that recognizes the sequence. Each amino acid is added, in turn, to the growing polypeptide at the specified position. After learning about transcription and translation through careful study of expository texts, students can simulate the processes on paper or with representative models. Computer software and commercial videos are available that illustrate animated sequences of transcription and translation.	mRNA protein [polypeptide chain] amino acid transcription & translation Central Dogma of Molecular Biology Ribosomes Codons RNA polymerase Anticodon tRNA start and stop codons	Which of the following relationships is the most similar to the relationship below? **nucleotide: DNA** a. amino acid : protein b. codons : tRNA c. mRNA : anticodons d. carbohydrate : glucose **DOK Level: 2 [Analysis]**
4b. Students know how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.	The sequence of amino acids in protein is provided by the genetic information found in DNA. In prokaryotes, mRNA transcripts of a coding sequence are copied from the DNA as a single contiguous sequence. In eukaryotes, the initial RNA transcript, while in the nucleus, is composed of exons, sequences of nucleotides that carry useful information for protein synthesis, and introns, sequences that do not. Before leaving the nucleus, the initial transcript is processed to remove introns and splice exons together. The processed transcript, then properly called mRNA and carrying the appropriate codon sequence for a protein, is transported from the nucleus to the ribosome for translation.	Initial mRNA transcript Introns Exons Excised Ligated Ligase Processed transcript	1. A segment of a DNA strand has the following bases: **TAC GAT** What is the complementary strand of DNA? a. UAG CAU c. AUG CUA b. TAG CAT d. ATG CTA **DOK LEVEL: 2 [Analysis]** 2. Given the original DNA strand below [and using the table of codons provided above], what would the final polypeptide chain be? TACGGGACCCTAGGTCCAAATCCTAACCAAATC Exon Intron Exon Intron Exon a. ile-stop c. met-pro-trp-gly-arg-leu-stop b. met-ile-gln-val-stop d. ile-gln-val-val-stop **DOK LEVEL: 3 [Evaluation/Strategic Thinking]**

California Content Standard	Clarification [Science Frameworks]	Key Ideas & Vocabulary**	Sample Test Item
4c. Students know 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 the encoded protein.	Mutations are permanent changes in the sequence of nitrogen-containing bases in DNA (see Standard 5.a in this section for details on DNA structure and nitrogen bases). Mutations occur when base pairs are incorrectly matched (e.g., A bonded to C rather than A bonded to T) and can, but usually do not, improve the product coded by the gene. Inserting or deleting base pairs in an existing gene can cause a mutation by changing the codon reading frame used by a ribosome. Mutations that occur in somatic, or nongerm, cells are often not detected because they cannot be passed on to offspring. They may, however, give rise to cancer or other undesirable cellular changes. Mutations in the germline can produce functionally different proteins that cause such genetic diseases as Tay-Sachs, sickle cell anemia, and Duchenne muscular dystrophy.	Mutations Deletion Insertion Codon Reading frame Cancer Tay-Sach's Sickle cell anemia Duchenne's Muscular Dystrophy Genetic disorders Silent mutation	A DNA segment is changed from-AATTAG- to -AAATAG-. This is a _____. a. frameshift mutation b. insertion c. substitution d. deletion **DOK Level: 2 [Analysis]**
5a. Students know the general structures and functions of DNA, RNA, and protein.	Nucleic acids are polymers composed of monomers called nucleotides. Each nucleotide consists of three subunits: a five-carbon pentose sugar, a phosphoric acid group, and one of four nitrogen bases. (For DNA these nitrogen bases are adenine, guanine, cytosine, or thymine.) DNA and RNA differ in a number of major ways. A DNA nucleotide contains a deoxyribose sugar, but RNA contains ribose sugar. The nitrogen bases in RNA are the same as those in DNA except that thymine is replaced by uracil. RNA consists of only one strand of nucleotides instead of two as in DNA. The DNA molecule consists of two strands twisted around each other into a double helix resembling a ladder twisted around its long axis. The outside, or uprights, of the ladder are formed by the two sugar-phosphate backbones. The rungs of the ladder are composed of pairs of nitrogen bases, one extending from each upright. In DNA these nitrogen bases always pair so that T pairs with A, and G pairs with C. This pairing is the reason DNA acts as a template for its own replication. RNA exists in many structural forms, many of which play different roles in protein synthesis. The mRNA form serves as a template during protein synthesis, and its codons are recognized by aminoacylated tRNAs. Protein and rRNA make up the structure of the ribosome. Proteins are polymers composed of amino acid monomers (see Standard Set 10 for chemistry in this chapter). Different types of proteins function as enzymes and transport molecules, hormones, structural components of cells, and antibodies that fight infection. Most cells in an individual organism carry the same set of DNA instructions but do not use the entire DNA set all the time. Only a small amount of the DNA appropriate to the function of that cell is expressed. Genes are, therefore, turned on or turned off as needed by the cell, and the products coded by these genes are produced only when required.	Nucleic acids Nucleotides Pentose sugar Phosphate group Deoxyribose sugar Uracil Thymine Guanine Adenine Thymine Double helix RNA vs. DNA	The structure of DNA resembles a twisted ladder. Which part of the nucleotide is found comprising the "rungs" of the ladder? a. deoxyribose b. ribose sugar c. ***nitrogenous bases*** d. phosphate groups DOK Level: [1] Recall & Reproduction*

California Content Standard	Clarification [Science Frameworks]	Key Ideas & Vocabulary**	Sample Test Item
5b. Students know how to apply base-pairing rules to explain precise copying of DNA during semiconservative replication and transcription of information from DNA into mRNA.	Enzymes initiate DNA replication by unzipping, or unwinding, the double helix to separate the two parental strands. Each strand acts as a template to form a complementary daughter strand of DNA. The new daughter strands are formed when complementary new nucleotides are added to the bases of the nucleotides on the parental strands. The nucleotide sequence of the parental strand dictates the order of the nucleotides in the daughter strands. One parental strand is conserved and joins a newly synthesized complementary strand to form the new double helix; this process is called semiconservative replication. DNA replication is usually initiated by the separation of DNA strands in a small region to make a "replication bubble" in which DNA synthesis is primed. The DNA strands progressively unwind and are replicated as the replication bubble expands, and the two forks of replication move in opposite directions along the chromosome. At each of the diverging replication forks, the strand that is conserved remains a single, continuous "leading" strand, and the other "lagging" complementary strand is made as a series of short fragments that are subsequently repaired and ligated together. Students may visualize DNA by constructing models, and they can simulate semiconservative replication by tracing the synthesis of the leading and lagging	Helicase DNA Polymerase Ligase Nucleotide sequence Complementary Base Pairing DNA Replication Semi-conservative Replication bubble Okazaki fragments Continuous vs. Discontinuous synthesis Lagging vs. Leading strand Ligated Anti-parallel orientation Directionality	A scientist analyzed the base composition present in a certain cell. He generated the incomplete data shown on the table below: **Base** / **Percent** A / 28 % G / T / C / What would be the expected % Thymine content of the cell? a. 13% c. 28% b. 14% d. 56% **DOK Level: 2 [Analysis]**

Subject Area Standards Assessment [SASA] Guide

COURSE: ***BIOLOGY*** • UNIT: 3 • TOPIC: ***GENETICS OF INHERITANCE***

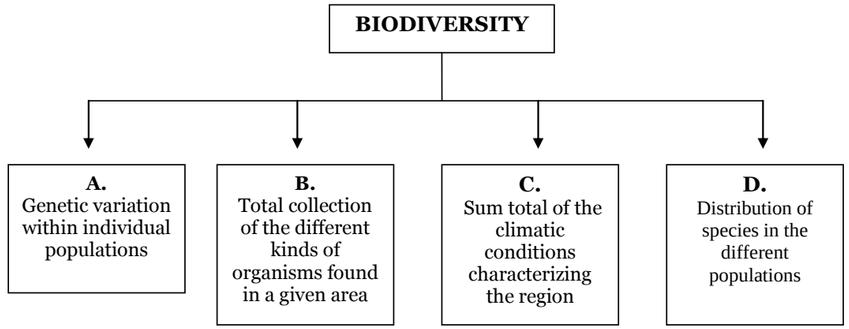
California Content Standard	Clarification [Science Frameworks]	Key Ideas & Vocabulary**	Sample Test Item
2a. Students know meiosis is an early step in sexual reproduction in which the pairs of chromosomes separate and segregate randomly during cell division to produce gametes containing one chromosome of each type.	Haploid gamete production through meiosis involves two cell divisions. During meiosis prophase I, the homologous chromosomes are paired, a process that abets the exchange of chromosome parts through breakage and reunion. The second meiotic division parallels the mechanics of mitosis except that this division is not preceded by a round of DNA replication; therefore, the cells end up with the haploid number of chromosomes. (The nucleus in a haploid cell contains one set of chromosomes.) Four haploid nuclei are produced from the two divisions that characterize meiosis, and each of the four resulting cells has different chromosomal constituents (components). In the male all four become sperm cells. In the female only one becomes an egg, while the other three remain small degenerate polar bodies and cannot be fertilized. Chromosome models can be constructed and used to illustrate the segregation taking place during the phases of mitosis (covered initially in Standard 1.e for grade seven in Chapter 4) and meiosis. Commercially available optical microscope slides also show cells captured in mitosis (onion root tip) or meiosis (Ascaris blastocyst cells), and computer and video animations are also available.	MEIOSIS STAGES OF MEIOSIS CELL CYCLE POLAR BODIES EGG, SPERM GAMETES SOMATIC CELLS MEIOSIS I vs. MEIOSIS II	Study the diagram below:  1. Which stage of Meiosis is being depicted? a. Prophase I b. Prophase II c. Anaphase I d. Anaphase II *From: www.biologycorner.com* **DOK Level: 2 [Application & Analysis]**
2b. Students know only certain cells in a multicellular organism undergo meiosis.	Only special diploid cells, called spermatogonia in the testis of the male and oogonia in the female ovary, undergo meiotic divisions to produce the haploid sperm and haploid eggs.	SPERMATOGENESIS OOGENESIS HAPLOID DIPLOID OVARY TESTES	2. A spermatogonium with a diploid number of 24 undergoes meiosis, how many chromosomes are in each spermatozoa produced? a. 6 b. 12 c. 24 d. 48 *From: www.biologycorner.com* **DOK Level: 2 [Application & Analysis]**
2c. Students know how random chromosome segregation explains the probability that a particular allele will be in a gamete.	The steps in meiosis involve random chromosome segregation, a process that accounts for the probability that a particular allele will be packaged in any given gamete. This process allows for genetic predictions based on laws of probability that pertain to genetic sortings. Students can create a genetic chart and mark alternate traits on chromosomes, one expression coming from the mother and another expression coming from the father. Students can be shown that partitions of the chromosomes are controlled by chance (are random) and that separation (segregation) of chromosomes during *karyokinesis* (division of the nucleus) leads to the random sequestering of different combinations of chromosomes.	CHROMOSOME SEGREGATION LAWS OF PROBABILITY GENETIC CHART PUNNETT SQUARE TRAITS ALLELES RANDOM KARYOKINESIS CYTOKINESIS	3. If cells of the genotype 'SsYyRr' undergo meiosis, how many types of gametes will be produced? Assume that the S, Y, and R genes reside on separate chromosome. a. 3 b. 4 c. 8 d. 16 *From: Freeman and Company's Life: The Science of Biology* *www.Sumanasinc.com* **DOK Level: 2 [Application & Analysis]**

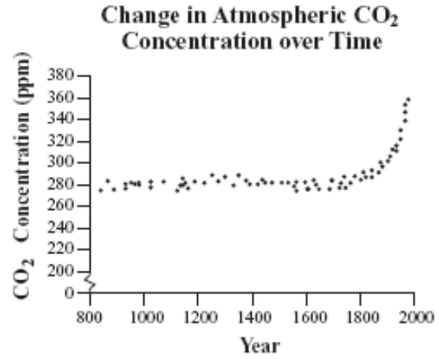
California Content Standard	Clarification [Science Frameworks]	Key Ideas & Vocabulary**	Sample Test Item
2d. Students know new combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization).	Once gametes are formed, the second half of sexual reproduction can take place. In this process a diploid organism is reconstituted from two haploid parts. When a sperm is coupled with an egg, a fertilized egg (zygote) is produced that contains the combined genotypes of the parents to produce a new allelic composition for the progeny. Genetic charts can be used to illustrate how new combinations of alleles may be present in a zygote through the events of meiosis and the chance union of gametes. Students should be able to read the genetic diploid karyotype, or chromosomal makeup, of a fertilized egg and compare the allelic composition of progeny with the genotypes and phenotypes of the parents.	FERTILIZATION ZYGOTE KARYOTYPE ALLELES GENES FERTILIZED EGG	**4. The phenotype of an animal depends MOST directly on _____.** **A** how the genes of the animal are expressed. **B** the metabolic rate of the animal. **C** the source of the animal's food. **D** how many cells are in the animal's body. **DOK Level: 1 [Recall & Reproduction]** **5. What is photographed to create a karyotype?** A Mutations B Genes C Gametes D Chromosomes From: Mississippi Standardized Testing Program [Spring 2006] **DOK Level: 1 [Recall & Reproduction]**
2e. Students know why approximately half of an individual's DNA sequence comes from each parent.	Chromosomes are composed of a single, very long molecule of double-stranded DNA and proteins. Genes are defined as segments of DNA that code for polypeptides (proteins). During fertilization half the DNA of the progeny comes from the gamete of one parent, and the other half comes from the gamete of the other parent.	POLYPEPTIDES OFFSPRING, PROGENY	**6. Which of the following statements BEST explains the relationship between the parts of genetic materials?** A Each DNA molecule contains genes. B Each gene contains many DNA molecules. C Each DNA molecule contains many chromosomes. D Each chromosome contains DNA molecules. From: Mississippi Standardized Testing Program Biology, Part II [Spring 2006] **DOK Level: 1 [Recall & Reproduction]**
2f. Students know the role of chromosomes in determining an individual's sex.	The normal human somatic cell contains 46 chromosomes, of which 44 are pairs of homologous chromosomes and 2 are sex chromosomes. Females usually carry two X chromosomes, and males possess one X and a smaller Y chromosome. Combinations of these two sex chromosomes determine the sex of the progeny.	XX vs. XY 46 chromosomes 23 pairs of chromosomes	**7. A condition that PRIMARILY affects males is probably _____.** A X-linked. B autosomal. C codominant. D recessive. From: Mississippi Standardized Testing Program Biology, Part II [Spring 2006] **DOK Level: 2 [Analysis & Application]**
3a. Students know 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	Monohybrid crosses, including autosomal dominant alleles, autosomal recessive alleles, incomplete dominant alleles, and X-linked alleles, can be used to indicate the parental genotypes and phenotypes. The possible gametes derived from each parent are based on genotypic ratios and can be used to predict possible progeny. The predictive (probabilistic) methods for determining the	DIHYBRID CROSS MONOHYBRID CROSS DOMINANT vs. RECESSIVE ALLELES PROGENY	**8. Humans may have type O, A, B, or AB blood. This blood type is a trait that is determined by —** **A** a double crossover on the X chromosome. **B** multiple alleles. **C** genes on Y chromosomes only.

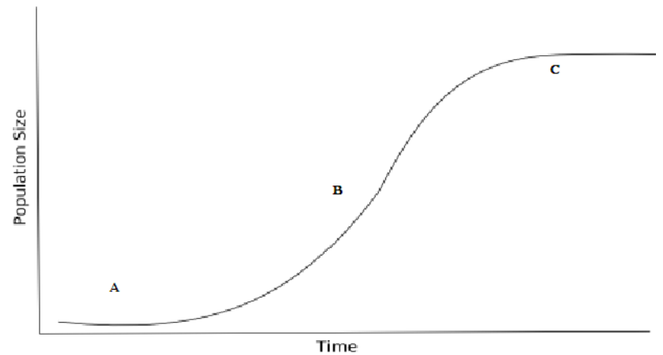
or recessive).	outcome of genotypes and phenotypes in a genetic cross can be introduced by using Punnett Squares and probability mathematics. Teachers should review the process of writing genotypes and help students translate genotypes into phenotypes. Teachers should emphasize dominant, recessive, and incomplete dominance as the students advance to an explanation of monohybrid crosses illustrating human conditions characterized by autosomal recessive alleles, such as albinism, cystic fibrosis, Tay-Sachs, and phenylketonuria (PKU). These disorders can be contrasted with those produced by possession of just one autosomal dominant allele, conditions such as Huntington disease, dwarfism, and neurofibromatosis. This basic introduction can be followed with examples of incomplete dominance, such as seen in the comparisons of straight, curly, and wavy hair or in the expression of intermediate flower colors in snapdragon plants. Sex-linked characteristics that are found only on the X chromosome should also be considered, and students should reflect on how this mode of transmission can cause the exclusive or near-exclusive appearance in males of color blindness, hemophilia, fragile-X syndrome, and sex-linked muscular dystrophy.	GENOTYPE PHENOTYPE SEX-LINKED INHERITANCE INCOMPLETE DOMINANCE HUNTINGTON DISEASE TAY-SACH'S HEMOPHILIA MUSCULAR DYSTROPHY COLOR BLINDNESS	**D** three homologous chromosomes. From: Mississippi Standardized Testing Program Spring 2006 **DOK Level: 1 [Recall and Reproduction]** **9. Assume that brown eyes (B) are dominant over tan eyes (b) in guinea pigs. When a brown-eyed male is mated with a tan-eyed female, 50% of the litter has brown eyes and 50% has tan eyes. What is the genotype of the female guinea pig?** **A** BB **B** Bb **C** bB **D** bb From: Mississippi Standardized Testing Program Spring 2006 **DOK Level: 2 [Analysis & Application]**
3b. Students know the genetic basis for Mendel's laws of segregation and independent assortment.	Mendel deduced that for each characteristic, an organism inherits two genes, one from each parent. When the two alleles differ, the dominant allele is expressed, and the recessive allele remains hidden. Two genes or alleles separate (segregate) during gamete production in meiosis, resulting in the sorting of alleles into separate gametes (the law of segregation). Students can be shown how to diagram Mendel's explanation for how a trait present in the parental generation can appear to vanish in the first filial (F1) generation of a monohybrid cross and then reappear in the following second filial (F2) generation. Students should be told that alternate versions of a gene at a single locus are called alleles. Students should understand Mendel's deduction that for each character, an organism inherits two genes, one from each parent. From this point students should realize that if the two alleles differ, the dominant allele, if there is one, is expressed, and the recessive allele remains hidden. Students should recall that the two genes, or alleles, separate (segregate) during gamete production in meiosis and that this sorting of alleles into separate gametes is the basis for the law of segregation. This law applies most accurately when genes reside on separate chromosomes that segregate out at random, and it often does not apply or is a poor predictor for combinations and frequencies of genes that reside on the same chromosome. Students can study various resources that describe Mendel's logic and build models to illustrate the laws of segregation and independent assortment.	F_1 vs. F_2 Generations GENE LOCUS MENDEL'S LAWS -Law of Segregation -Law of Independent Assortment	**10. Mendel referred to the parental generation in the cross pollination between two true-breeding plants as the ____ generation** a. F1 b. F2 c. P d. P1 From: www.biology.about.com **DOK Level: 1 [Recall and Reproduction]**

Subject Area Standards Assessment [SASA] Guide

COURSE: ***BIOLOGY*** • UNIT: 4 • TOPIC: ***ECOLOGY***

California Content Standard	Clarification [Science Frameworks]	Key Ideas & Vocabulary**	Sample Test Item
6a. Students know biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.	Biodiversity refers to the collective variety of living organisms in an ecosystem. This structure is influenced by alterations in habitat, including but not limited to climatic changes, fire, flood, and invasion by organisms from another system. The more biodiversity in an ecosystem, the greater its stability and resiliency. The best way for students to learn about ecology is to master the principles of the subject through careful study and then to make firsthand observations of ecosystems in action over time. Although field trips are the ideal way to implement this process and should be encouraged, even career scientists often use models to study ecology. Local ecologists from government, private industry, or university programs may also be willing to serve as guest speakers in the classroom. Viewing the Internet's many virtual windows that show actual ecological experiments can also help students understand the scientific basis of ecology.	Biodiversity Species Populations Communities Ecology Succession Primary succession Secondary succession Habitat Climate	A student created the following graphic organizer:  Which box contains inaccurate [wrong] information? 1. A 2. B 3. C 4. ***D*** **DOK LEVEL: 2 [Analysis]***
6b. Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species,	Analysis of change can help people to describe and understand what is happening in a natural system and, to some extent, to control or influence that system. Understanding different kinds of change can help to improve predictions of what will happen next. Changes in	Non-native species Population cycles Migrations	

or changes in population size.	ecosystems often manifest themselves in predictable patterns of climate, seasonal reproductive cycles, population cycles, and migrations. However, unexpected disturbances caused by human intervention or the introduction of a new species, for example, may destabilize the often complex and delicate balance in an ecosystem. Analyzing changes in an ecosystem can require complex methods and techniques because variation is not necessarily simple and may be interrelated with changes or trends in other factors. Rates and patterns of change, including trends, cycles, and irregularities, are essential features of the living world and are useful indicators of change that can provide data for analysis. Often it is important to analyze change over time, a process called longitudinal analysis.		The atmospheric carbon dioxide concentration over time is shown below:  Scientists are investigating the cause of the large increase in atmospheric carbon dioxide concentration since about 1800. Which of the following provides the **best** explanation for the increase? a. Large volcanic eruptions b. Fossil fuel burning by humans c. Natural fluctuations in climate d. Active photosynthesis by planktons **DOK LEVEL: 2 [Analysis]** Source: CST Released Test Questions

California Content Standard	Clarification [Science Frameworks]	Key Ideas & Vocabulary**	Sample Test Item
6c. Students know how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.	Fluctuations in the size of a population are often difficult to measure directly but may be estimated by measuring the relative rates of birth, death, immigration, and emigration in a population. The number of deaths and emigrations over time will decrease a population's size, and the number of births and immigrations over time will increase it. Comparing rates for death and emigration with those for birth and immigration will determine whether the population shows a net growth or a decline over time.	Birth [natality] Rate Death [mortality] Rate Emigration Rate Immigration Rate Population Growth Curves Population Distribution [random, clumped, uniform]	Study the population growth curve below:  The lag phase, characterized by slow population growth, occurs at which point of the graph? a. **A** b. B c. C d. D **DOK Level: 2 [Analysis]**

California Content Standard	Clarification [Science Frameworks]	Key Ideas & Vocabulary**	Sample Test Item
6d. Students know how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.	Living things depend on nonliving things for life. At the organism level living things depend on natural resources, and at the molecular level, they depend on chemical cycles. Water, carbon, nitrogen, phosphorus, and other elements are recycled back and forth between organisms and their environments. Water, carbon, and nitrogen are necessary for life to exist. These chemicals are incorporated into plants (producers) by photosynthesis and nitrogen fixation and used by animals (consumers) for food and protein synthesis. Chemical recycling occurs through respiration, the excretion of waste products and, of course, the death of organisms.	Abiotic vs. biotic Factors Biogeochemical cycles: -Nitrogen Cycle -Carbon Cycle -Water Cycle Reservoirs Photosynthesis Respiration Carbon dioxide Oxygen Nitrogen fixation N_2-fixing bacteria	Which of the following is an abiotic factor in an ecosystem? A. Grass B. Fox C. ***Rock*** D. Worm **DOK Level: 1 [Recall & Reproduction]**
6e. Students know a vital part of an ecosystem is the stability of its producers and decomposers.	An ecosystem's producers (plants and photosynthetic microorganisms) and decomposers (fungi and microorganisms) are primarily responsible for the productivity and recycling of organic matter, respectively. Conditions that threaten the stability of producer and decomposer populations in an ecosystem jeopardize the availability of energy and the capability of matter to recycle in the rest of the biological community. To study the interaction between producers and decomposers, students can set up a closed or restricted ecosystem, such as a worm farm, a composting system, a terrarium, or an aquarium.	Food chain Trophic levels Producers Consumers [1^o and 2^o] Decomposers Nutrients Microorganisms Fungi Organic matter	Which of the following desert organisms is a producer? A. fox B. lizard C. ***cactus*** D. scorpion *From: Texas State Assessments* http://www.tea.state.tx.us/student.assessment/resources/online/2002/eoc/biology.html **DOK Level: 2 [Application]**

6f. Students know at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid.	The energy pyramid illustrates how stored energy is passed from one organism to another. At every level in a food web, an organism uses energy metabolically to survive and grow, but much is released as heat, usually about 90 percent. At every link in a food web, energy is transferred to the next level, but typically only 10 percent of the energy from the previous level is passed on to the consumer.	Food Web Energy transfer Heat energy	What is the maximum percentage of food energy available to a wolf that consumes a herbivorous mouse? A. 0.1% ***B. 1%*** C. 10% D. 100% From: Texas State Assessments http://www.tea.state.tx.us/student.assessment/resources/online/2002/eoc/biology.html **DOK Level: 3 [Evaluation and Synthesis]**

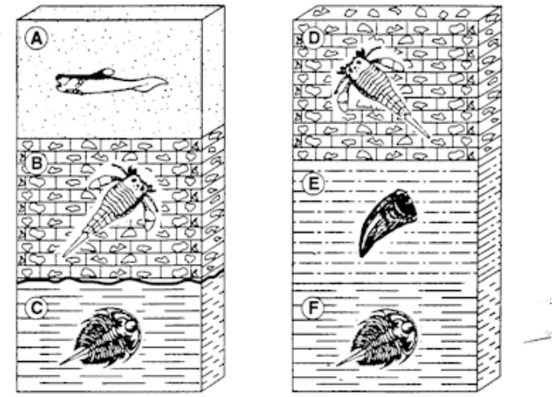
Subject Area Standards Assessment [SASA] Guide

COURSE: ***BIOLOGY*** • UNIT: 5 • TOPIC: ***EVOLUTION***

State Content Standards	According to the Frameworks	KEY IDEAS & VOCABULARY**	Sample Test Item
7a. Students know why natural selection acts on the phenotype rather than the genotype of an organism.	Natural selection works directly on the expression or appearance of an inherited trait, the phenotype, rather than on the gene combination that produces that trait, the genotype. The influence of a dominant allele for a trait over a recessive one in the genotype determines the resulting phenotype on which natural selection acts.	Evolution Natural selection Phenotype, genotype Genetic variation Survival of the fittest Fitness Adaptation	1. A student wrote the following notes about natural selection: *A. Natural selection is a mechanism for evolution proposed by Wallace and Darwin.* *B. Natural selection acts on the set of genes possessed by organisms.* *C. Natural selection relies on the presence of genetic variation among species in a population.* *D. Some organisms survive and succeed in reproducing because they are better-adapted to their environment.* One of the statements written is incorrect. Which one is it? a. A b. B c. C d. D **DOK Level: 2 [Analysis]***
7b. Students know why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus, maintained in the gene pool.	Two types of allele pairings can occur in the genotype: homozygous (pairing two of the same alleles, whether dominant, co-dominant, or recessive) and heterozygous (pairing of two different alleles). Recessive lethal alleles (e.g., Tay-Sachs disease) will, by definition, cause the death of only the homozygous recessive individual. Healthy heterozygous individuals will also contribute the masked recessive gene to the population's gene pool, allowing the gene to persist.	Lethal gene Gene pool Recessive lethal alleles	2. In carrier pigeons there is a rare inherited condition that causes the death of the chicks before hatching. In order for this disease to be passed from generation to generation there must be parent birds that... A are heterozygous for the disease. B produce new mutations for this disease. C have the disease themselves. D are closely interbred. From: 2008 CST Released Test Questions **DOK Level: 2 [Analysis]***
7c. Students know new mutations are constantly being generated in a gene pool.	Mutation is an important source of genetic variation within a gene pool. These random changes take the form of additions, deletions, and substitutions of nucleotides and of rearrangements of chromosomes. The effect of many mutations is minor and neutral, being neither favorable nor unfavorable to survival and reproduction. Other mutations may be beneficial or harmful. The important principle is that culling, or selective breeding, cannot eliminate	Mutation Genetic variation Culling or selective breeding Unwanted traits	3. Hemophilia, a genetic disease is expressed by a recessive allele. This disease may suddenly appear after several generations because it is… A. carried in a heterozygote without being expressed. B. produced by new mutations in future generations. C. incompletely dominant

	genetic diseases or unwanted traits from a population. The trait constantly reappears in the population in the form of new, spontaneous mutations.		D. turned on by hormones of the endocrine glands From: http://www2.visalia.k12.ca.us/eldiamante/science/biology/taters/evolution_mc.htm **DOK Level: 2 [Analysis]***
State Content Standards	**According to the Frameworks**	**KEY IDEAS & VOCABULARY****	**Sample Test Item**
7d.Student knows that variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.	As environmental factors change, natural selection of adaptive traits must also be realigned. Variation within a species stemming either from mutation or from genetic recombination broadens the opportunity for that species to adapt to change, increasing the probability that at least some members of the species will be suitably adapted to the new conditions. Genetic diversity promotes survival of a species should the environment change significantly, and sameness can mean vulnerability that could lead to extinction.	Genetic variation Genetic diversity Extinction Species	4. According to the theory of natural selection, a species that lacks the variations necessary to adapt to a changing environment will most likely — a. become dormant b. mutate c. become extinct d. fossilize From: Texas State Assessments Biology 2002 **DOK Level: 1 [Recall and Reproduction]***
8a/8b. Students know how natural selection determines the differential survival of groups of organisms. Great diversity increases the chance that some organisms survive major changes in the environment.	Genetic changes can result from gene recombination during gamete formation and from mutations. These events are responsible for variety and diversity within each species. Natural selection favors the organisms that are better suited to survive in a given environment. Those not well suited to the environment may die before they can pass on their traits to the next generation. As the environment changes, selection for adaptive traits is realigned with the change. Traits that were once adaptive may become disadvantageous because of change. Students can explore the process of natural selection further with an activity based on predator-prey relationships. The main purpose of these activities is to simulate survival in predator or prey species as they struggle to find food or to escape being consumed themselves. The traits of predator and prey individuals can be varied to test their selective fitness in different environmental settings. An example of natural selection is the effect of industrial "melanism," or darkness of pigmentation, on the peppered moths of Manchester, England. These moths come in two varieties, one darker than the other. Before the industrial revolution, the dark moth was rare; however, during the industrial revolution the light moth seldom appeared. Throughout the industrial revolution, much coal was burned in the region, emitting soot and sulfur dioxide. For reasons not completely understood, the light-colored moth had successfully adapted to the cleaner air conditions that existed in preindustrial times and that exist in the region today. However, the light-colored moth appears to have lost its survival advantage during times of heavy industrial air pollution. One early explanation is that when soot covered tree bark, light moths became highly visible to predatory birds. Once this change happened, the dark-peppered moth had an inherited survival advantage because it	Gene recombination Gamete formation Industrial melanism Camouflage Intra-species diversity	5. Which of these best illustrates natural selection? a. An organism with favorable genetic variations will tend to survive and breed successfully. b. A population monopolizes all of the resources in its habitat, forcing other species to migrate. c. A community whose members work together utilizes all existing resources and migratory routes. d. The largest organisms in a species receive the only breeding opportunities. *From: 2008 CST Released Test Questions* **DOK Level: 1 [Recall & Reproduction]*** 6. In a mouse population inhabiting a grassland area, a mutation occurs that results in a new coat color allele. Which of the following factors has the greatest effect on whether the new coat color will become more common in the mouse population? A. whether abundant food is available in the grassland B. whether the new coat color allele is dominant or recessive C. whether the rate of reproduction in the mouse population is stable D. whether the new coat color allele increases the survival of mice in their environment *From: Massachusetts State Examinations BIO 2007* **DOK Level: 2 [Analysis]***

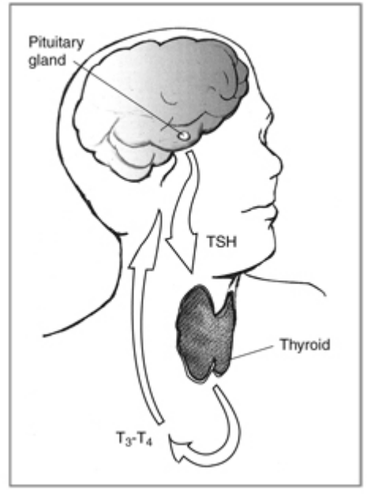
	was harder to see against the sooty background. This explanation may not have been the cause, and an alternative one is that the white-peppered moth was more susceptible to the sulfur dioxide emissions of the industrial revolution. In any case, in the evolution of the moth, mutations of the genes produced light and dark moths. Through natural selection the light moth had an adaptive advantage until environmental conditions changed, increasing the population of the dark moths and depleting that of the light moths. [8b] This standard is similar to the previous standard set on diversity within a species but takes student understanding one step further by addressing diversity among and between species. For the same reasons pertinent to those for intra-species diversity, increased diversity among species increases the chances that some species will adapt to survive future environmental changes.		
State Content Standards	**According to the Frameworks**	**KEY IDEAS & VOCABULARY****	**Sample Test Item**
8c. Students know the effects of genetic drift on the diversity of organisms in a population.	If a small random sample of individuals is separated from a larger population, the gene frequencies in the sample may differ significantly from those in the population as a whole. The shifts in frequency depend only on which individuals fall in the sample (and so are themselves random). Because a random shift in gene frequency is not guaranteed to make the next generation better adapted, the shift—or genetic drift—with respect to the original gene pool is not necessarily an adaptive change. The bottleneck effect (i.e., nonselective population reductions due to disasters) and the founder effect (i.e., the colonization of a new habitat by a few individuals) describe situations that can lead to genetic drift of small populations.	Bottleneck effect Genetic drift Gene frequencies Random Non-selective Colonization Habitat Founder Effect	7. A small population of chimpanzees lives in a habitat that undergoes no changes for a long period. How will genetic drift probably affect this population? a. It will accelerate the appearance of new traits. b. It will promote the survival of chimpanzees with beneficial traits. c. It will increase the number of alleles for specific traits. d. It will reduce genetic diversity. From: 2008 CST Released Test Questions **DOK Level: 2 [Analysis]***
8d. Students know that reproductive and geographic isolation affects speciation.	Events that lead to reproductive isolation of populations of the same species cause new species to appear. Barriers to reproduction that prevent mating between populations are called pre-zygotic (before fertilization) if they involve such factors as the isolation of habitats, a difference in breeding season or mating behavior, or an incompatibility of genitalia or gametes. Post-zygotic (after fertilization) barriers that prevent the development of viable, fertile hybrids exist because of genetic incompatibility between the populations, hybrid sterility, and hybrid breakdown. These isolation events can occur within the geographic range of a parent population (sympatric speciation) or through the geographic isolation of a small population from its parent population (allopatric speciation). Sympatric speciation is much more common in plants than in animals. Extra sets of chromosomes, or polypoidy, that result from mistakes in cell division produce plants still capable of long-term reproduction but animals that are incapable of that process because polypoidy interferes with sex determination and because animals, unlike most plants, are usually of one sex or the other. Allopatric	Reproductive isolation Geographic isolation Allopatric speciation Polyploidy Pre-zygotic vs. Post-zygotic Barriers Mating behaviors Speciation	8. Geographic and reproductive isolation are most closely associated with… a. speciation c. overproduction b. extinction d. competition From: NY Regents Examination 2001 **DOK Level: 1 [Recall & Reproduction]*** 9. In order for a species to survive, it must be able to — F consume a wide variety of food G reproduce successfully H maintain a constant body temperature J destroy competing species **DOK Level: 1 [Recall & Reproduction]*** From: 2002 Texas State Assessments [Biology]

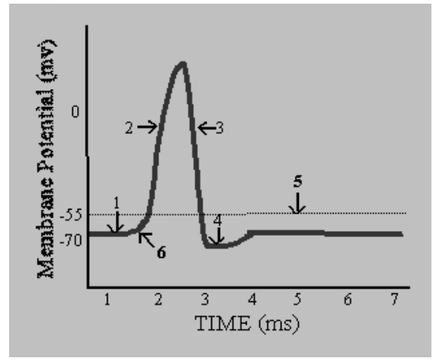
	speciation occurs in animal evolution when geographically isolated populations adapt to different environmental conditions. In addition, the rate of allopatric speciation is faster in small populations than in large ones because of greater genetic drift.		
State Content Standards	**According to the Frameworks**	**KEY IDEAS & VOCABULARY****	**Sample Test Item**
8e. Students know how to analyze fossil evidence with regard to biological diversity, episodic speciation and mass extinction	Analysis of the fossil record reveals the story of major events in the history of life on earth, sometimes called macroevolution, as opposed to the small changes in genes and chromosomes that occur within a single population, or microevolution. Explosive radiations of life following mass extinctions are marked by the four eras in the geologic time scale: the Precambrian, Paleozoic, Mesozoic, and Cenozoic. The study of biological diversity from the fossil record is generally limited to the study of the differences among species instead of the differences within a species. Biological diversity within a species is difficult to study because preserved organic material is rare as a source of DNA in fossils. Episodes of speciation are the most dramatic after the appearance of novel characteristics, such as feathers and wings, or in the aftermath of a mass extinction that has cleared the way for new species to inhabit recently vacated adaptive zones. Extinction is inevitable in a changing world, but examples of mass extinction from the fossil record coincide with rapid global environmental changes. During the formation of the supercontinent Pangaea during the Permian period, most marine invertebrate species disappeared with the loss of their coastal habitats. During the Cretaceous period a climatic shift to cooler temperatures because of diminished solar energy coincided with the extinction of dinosaurs.	Fossil record Fossil formation Mass extinctions Radioactive dating Law of Superposition Relative dating Geologic Time Pangaea Dinosaurs Geologic Periods, Eras	 10. In which sequence are the rock layers listed in order from oldest to youngest? A). F, B, E, D B). C, A, F, D C). F, E, C, A D). C, E, D, A From: 1996 New York Regents Examination Biology **DOK Level: 3 [Evaluation]**

Subject Area Standards Assessment [SASA] Guide

COURSE: ***BIOLOGY*** • UNIT: 6 • TOPIC: ***Anatomy and Physiology***

Standard	Clarification from the Science Frameworks:	KEY IDEAS & VOCABULARY**	Sample Test Item
9a. Students know how the complementary activity of major body systems provides cells with oxygen and nutrients and removes toxic waste products such as carbon dioxide.	The digestive system delivers nutrients (e.g., glucose) to the circulatory system. Oxygen molecules move from the air to the alveoli of the lungs and then to the circulatory system. From the circulatory system glucose and oxygen molecules move from the capillaries into the cells of the body where cellular respiration occurs. During cellular respiration these molecules are oxidized into carbon dioxide and water, and energy is trapped in the form of ATP. The gas exchange process is reversed for the removal of carbon dioxide from its higher concentration in the cells to the circulatory system and, finally, to its elimination by exhalation from the lungs. The concentration of sugar in the blood is monitored, and students should know that sugar can be stored or pulled from reserves (glycogen) in the liver and muscles to maintain a constant blood sugar level. Amino acids contained in proteins can also serve as an energy source, but first the amino acids must be deaminated, or chemically converted, in the liver, producing ammonia (a toxic product), which is converted to water-soluble urea and excreted by the kidneys. Teachers should emphasize that all these chemicals are transported by the circulatory system and the cells. Organs at the final destination direct these chemicals to their exit from the circulatory system.	DIGESTIVE SYSTEM RESPIRATORY SYSTEM EXCRETORY SYSTEM CIRCULATORY SYSTEM ATP CELLULAR RESPIRATION AMMONIA SUGAR/GLUCOSE CONCENTRATION GLYCOGEN	1. Which substances are metabolic waste products excreted by animals? a. Oxygen, Ammonia and Salts b. Glucose, Urea, and Carbon dioxide c. Uric Acid, Oxygen, and Water d. Water, Urea, and Carbon dioxide 1999 NY Regents Biology Examination **DOK LEVEL: 1 [RECALL & REPRODUCTION]** 2. What is the major function of the valves found in human veins? A Preventing movement of blood clots B Reducing the back flow of blood C Adding oxygen to blood plasma D Slowing the red blood cells From: 2001 Virginia Released Test Items [Biology] **DOK LEVEL: 1 [RECALL & REPRODUCTION]**
9b. Students know how the nervous system mediates communication between different parts of the body and the body's interactions with the environment	An individual becomes aware of the environment through the sense organs and other body receptors (e.g., by allowing for touch, taste, and smell and by collecting information about temperature, light, and sound). The body reflexively responds to external stimuli through a reflex arc (see Standard 9.e in this section). (A reflex arc is the pathway along the central nervous system where an impulse must travel to bring about a reflex; e.g., sneezing or coughing.) Students can examine the sense organs, identify other body receptors that make them aware of their environment, and see ways in which the body reflexively responds to an external stimulus through a reflex arc. Hormones work in conjunction with the nervous system, as shown, for example, in the digestive system, where insulin released from the pancreas into the blood regulates the uptake of glucose	NERVOUS SYSTEM ENDOCRINE SYSTEM HORMONES REFLEX ARC ORGANS AND RECEPTORS CNS, PNS STIMULUS RESPONSE PITUITARY GLAND HYPOTHALAMUS	3. Which of these secretes a hormone that regulates the rate of metabolism of the body? A spleen B cerebrum C thyroid D kidney 2008 CST Released Test Items **DOK LEVEL: 1 [RECALL & REPRODUCTION]**

	by muscle cells. The pituitary master gland produces growth hormone for controlling height. Other pituitary hormones have specialized roles (e.g., follicle-stimulating hormone [FSH] and luteinizing hormone [LH] control the gonads, thyroid-stimulating hormone [TSH] controls the thyroid, and adrenocorticotropic hormone [ACTH] regulates the formation of glucocorticoids by the adrenal cortex). This master gland is itself controlled by the hypothalamus of the brain.		
Standard	**Clarification from the Science Frameworks:**	**KEY IDEAS & VOCABULARY****	**Sample Test Item**
9c. Students know how feedback loops in the nervous and endocrine systems regulate conditions in the body.	Feedback loops are the means through which the nervous system uses the endocrine system to regulate body conditions. The presence or absence of hormones in blood brought to the brain by the circulatory system will trigger an attempt to regulate conditions in the body. To make feedback loops relevant to students, teachers can discuss the hormone leptin, which fat cells produce as they become filled with storage reserves. Leptin is carried by the blood to the brain, where it normally acts to inhibit the appetite center, an example of negative feedback. When fat reserves diminish, the concentration of leptin decreases, a phenomenon that in turn causes the appetite center in the brain to start the hunger stimulus and activate the urge to eat.	FEEDBACK LOOP ENDOCRINE SYSTEM GLANDS FAT RESERVES LEPTIN	4. Study the diagram of a feedback loop below:  In some individuals, overproduction of T3 and T4 hormones lead to a condition called hyperthyroidism. As its name implies, TSH [thyroid stimulating hormone] serves to stimulate the thyroid gland to increase production of T3 and T4 hormones. Which part of the feedback loop above serves to regulate this overproduction? a. Stimulation of the thyroid gland b. Increase in T3/T4 production c. Depression of Pituitary Gland secretion d. Decreased TSH production **DOK LEVEL: 2 [Analysis]**

Standard	Clarification from the Science Frameworks:	KEY IDEAS & VOCABULARY**	Sample Test Item
9d. Students know the functions of the nervous system and the role of neurons in transmitting electrochemical impulses.	Transmission of nerve impulses involves an electrochemical "action potential" generated by gated ion channels in the membrane that make use of the countervailing gradients of sodium and potassium ions across the membrane. Potassium ion concentration is high inside cells and low outside; sodium ion concentration is the opposite. The sodium and potassium ion concentration gradients are restored by an active transport system, a pump that exchanges sodium and potassium ions across the membrane and uses ATP hydrolysis as a source of free energy. The release of neurotransmitter chemicals from the axon terminal at the synapse may initiate an action potential in an adjacent neuron, propagating the impulse to a new cell.	ACTION POTENTIAL SYNAPSE VOLTAGE-GATED PUMPS POTASSIUM IONS SODIUM IONS MEMBRANE POTENTIAL RESTING POTENTIAL DEPOLARIZATION NEUROTRANSMITTER NEURON DENDRITES AXONS ACTIVE TRANSPORT Na^+/K^+ pumps	5. Study the graph below describing the electrical changes associated with the instigation of an action potential then answer the question. In which labeled part of the graph do potassium channels open and K^+ ions begin leaving? A 1 B 2 C 3 D 4 **DOK LEVEL: 2 [Analysis]** 
9e. Students know the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response	The pathways of impulses from dendrite to cell body to axon of sensory neurons, interneurons, and motor neurons link the chains of events that occur in a reflex action. Students should be able to diagram this pathway. Similar paths of neural connections lead to the brain, where the sensations become conscious and conscious actions are initiated in response to external stimuli. Students might also trace the path of the neural connections as the sensation becomes conscious and a response to the external stimulus is initiated. Students should also be able to identify gray and white matter in the central nervous system.	SENSORY NEURONS INTERNEURONS MOTOR NEURONS GRAY AND WHITE MATTER AXON DENDRITE	6. Which of the following are the parts of a neuron? a. brain, spinal cord, vertebral column b. sensory, motor, interneuron c. dendrite, axon, cell body d. sympathetic, parasympathetic From: www.mcgraw-hill.com **DOK LEVEL: 1 [RECALL & REPRODUCTION]**
10a. a. Students know the role of the skin in providing nonspecific defenses against infection.	The skin serves as a physical barrier to prevent the passage of many disease-causing microorganisms. Cuts and abrasions compromise the skin's ability to act as a barrier. Teachers can use charts and overhead projections to show the dangers and physiologic responses of a break in the skin.	NON-SPECIFIC IMMUNE RESPONSE BARRIER MICROORGANISMS PATHOGENS IMMUNE DEFENSES	7. Sweat and skin secretions contain a mixture of molecules that kills or limits the growth of many types of microbes. This control of microbes is an example of... **A** a nonspecific defense against infection. **B** an enzyme-catalyzed biochemical reaction. **C** a feedback loop to maintain homeostasis. **D** a specific immune response to infection by microbes. From: 2008 CST Released Test Questions **DOK LEVEL: 2 [Analysis and Application]**

			8. What organ is your first line of defense to entry of pathogens? A. thymus C. bone marrow B. skin D. brain From: http://www2.visalia.k12.ca.us/eldiamante/science/biology/taters/immune_mc.htm **DOK LEVEL: 1 [RECALL & REPRODUCTION]**
Standard	**Clarification from the Science Frameworks:**	**KEY IDEAS & VOCABULARY****	**Sample Test Item**
10b. Students know the role of antibodies in the body's response to infection.	Cells produce antibodies to oppose antigens, substances that are foreign to the body. An example of an antigen is a surface protein of a flu virus, a protein with a shape and structure unlike those of any human proteins. The immune system recognizes that the flu virus structure is different and generates proteins called antibodies that bind to the flu virus. Antibodies can inactivate pathogens directly or signal immune cells that pathogens are present.	ANTIBODIES ANTIGENS VIRUS BACTERIA	9. A doctor will prescribe you antibiotics for what types of infection? a. bacteria b. viruses c. cancer d. protist From: http://www2.visalia.k12.ca.us/eldiamante/science/biology/taters/immune_mc.htm **DOK LEVEL: 1 [RECALL & REPRODUCTION]**
10c. Students know how vaccination protects an individual from infectious diseases.	Several weeks are required before the immune system develops immunity to a new antigen. To overcome this problem, vaccinations safely give the body a look in advance at the foreign structures. Vaccines usually contain either weakened or killed pathogens that are responsible for a specific infectious disease, or they may contain a purified protein or subunit from the pathogen. Although the vaccine does not cause an infectious disease, the antigens in the mixture prompt the body to generate antibodies to oppose the pathogen. When the individual is exposed to the pathogenic agent, perhaps years later, the body still remembers having seen the antigens in the vaccine dose and can respond quickly. Students have been exposed to the practical aspects of immunization through their knowledge of the vaccinations they must receive before they can enter school. They have all experienced getting shots and may have seen their personal vaccination record in which dates and kinds of inoculations are recorded. The review of a typical vaccination record, focusing on the reason for the shots and ways in which they work, may serve as an effective entry to the subject. Students should review the history of vaccine use. Early literature provides descriptions of vaccine use from pragmatic exposure, but the term vaccine is derived from the cowpox exudate that Edward Jenner used during the 1700s to inoculate villagers against the more pathogenic smallpox. Louis Pasteur, noted for his discovery of the rabies treatment,	VACCINATIONS WEAKENED INFECTIOUS	10. A vaccine contains... a) antibodies that recognize invading microbes. b) inactivated disease-causing microbes. c) a hormone that boosts immunity. d) white blood cells that fight infection. From: http://biology.berkeley.edu/bio1a/topic/Immune_System/Quizzes/index.html **DOK LEVEL: 1 [RECALL & REPRODUCTION]**

	also developed several vaccines. Poliovirus, the cause of infantile paralysis (poliomyelitis), was finally conquered in the 1950s through vaccines that Jonas Salk and Albert B. Sabin refined.		
Standard	**Clarification from the Science Frameworks:**	**KEY IDEAS & VOCABULARY****	**Sample Test Item**
10d. Students know there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.	A virus, which is the simplest form of a genetic entity, is incapable of metabolic life and reproduction outside the cells of other living organisms. A virus contains genetic material but has no ribosomes. Although some viruses are benign, many harm their host organism by destroying or altering its cell structures. Generally, the body perceives viruses as antigens and produces antibodies to counteract the virus. Bacteria are organisms with a full cellular structure. They, too, can be benign or harmful. Harmful bacteria and their toxins are perceived as antigens by the body, which in turn produces antibodies. In some cases infectious diseases may be treated effectively with antiseptics, which are chemicals that oxidize or in other ways inactivate the infecting organism. Antiseptics are also useful in decontaminating surfaces with which the body may come in contact (e.g., countertops). Antibiotics are effective in treating bacterial infections, sometimes working by destroying or interfering with the growth of bacterial cell walls or the functioning of cell wall physiology or by inhibiting bacterial synthesis of DNA, RNA, or proteins. Antibiotics are ineffective in treating viral infections. Students might research infections caused by protists (malaria, amoebic dysentery), bacteria (blood poisoning, botulism, food poisoning, tuberculosis), and viruses (rabies, colds, influenza, AIDS). They might also investigate the pathogens currently being discussed in the media and study each infectious organism's requirements for growth and reproduction. Teachers should review the dangers of common bacteria becoming resistant to antibiotics through long-standing over-application, as shown by the increasing incidence of drug-resistant tuberculosis and other bacteria. Using a commercially available kit, teachers can demonstrate how antibiotics may act generally or specifically against bacteria. Agar plates may be inoculated with different bacteria, and different antibiotic discs may be placed on these plates to create a clear zone in which growth around the antibiotic discs is inhibited.	BACTERIA VS. VIRUSES ANTIBIOTICS ANTISEPTICS DECONTAMINATION	11. In 1847, a scientist noted that when physicians washed their hands before they had contact with their patients, there was a decreased number of infections. This was one of the first clues that — **F** bacteria generate spontaneously on hands **G** physicians deliberately infected patients **H** bacteria are present in water **J** substances such as bacteria may cause diseases From: 2007 Virginia State Released Test Items [Biology] **DOK LEVEL: 2 [APPLICATION AND ANALYSIS]**

10e. Students know why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.	When an immune system is compromised (e.g., through infection by the human immunodeficiency virus [HIV]), it becomes either unable to recognize a dangerous antigen or incapable of mounting an appropriate defense. This situation happens when the virus infects and destroys key cells in the immune system.	COMPROMISED IMMUNE SYSTEM HIV and AIDS WHITE BLOOD CELLS	The HIV virus severely decreases the number of which type of cells? A. Cytotoxic T cells B. Helper T cells C. Suppressor T cells D. Memory cells From: http://biology.about.com/od/organsystems/a/aa120304a.htm A person who has HIV/AIDS and a compromised immune system will not be able to... A. produce antigens B. produce red blood cells C. fight infections D. digest food properly From: http://www2.visalia.k12.ca.us/eldiamante/science/biology/taters/immune_mc.htm