

# CST and FINAL EXAM REVIEW

**Directions:** Both your final exam and the CST (STAR) test are based on the California Standards. There are five major categories and they include: **Investigation and Experimentation, Cell Biology, Genetics, Evolution and Ecology, and Physiology**. Each of the categories includes a number of topics that you should know about. I am including each of the California Standards and questions that pertain to each. Answer them completely using your notes and textbook as resources.

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## Investigation and Experimentation

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**BIIE1.** 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 reporting clusters, students should develop their own questions and perform investigations. Students will:

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**BIIE1. 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.

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**BIIE1. b.** Identify and communicate sources of unavoidable experimental error.

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**BIIE1. c.** Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.

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**BIIE1. d.** Formulate explanations by using logic and evidence.

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**BIIE1. e.** Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.

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**BIIE1. f.** Distinguish between hypothesis and theory as scientific terms.

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**BIIE1. g.** Recognize the usefulness and limitations of models and theories as scientific representations of reality.

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**BIIE1. h.** Read and interpret topographic and geologic maps.

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**BIIE1. i.** Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).

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**BIIE1. j.** Recognize the issues of statistical variability and the need for controlled tests.

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**BIIE1. k.** Recognize the cumulative nature of scientific evidence.

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**BIIE1. l.** Analyze situations and solve problems that require combining and applying concepts from more than one area of science.

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**BIIE1. m.** Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.

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**BIIE1. n.** 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).

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1. What is a **controlled experiment**?

2. What is the difference between a ***hypothesis*** and a ***theory***?

3. When conducting experiments, sometimes the results are not consistent and may yield results that are obviously wrong. What might be some typical sources of unavoidable errors?

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**Cell Biology**

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**BI1.**      **The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept:**

**BI1. a.**      *Students know* cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.

**BI1. b.**      *Students know* enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings.

**BI1. c.**      *Students know* how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure.

**BI1. d.**      *Students know* 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.

**BI1. e.**      *Students know* the role of the endoplasmic reticulum and Golgi apparatus in the secretion of proteins.

**BI1. f.**      *Students know* usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.

**BI1. g.**      *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.

**BI1. h.**      *Students know* most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors.

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4. Why is the cell membrane referred to as being semi-permeable?

5. The ***cell membrane*** can be referred to as a mosaic. What is the cell membrane composed of? (**Draw a diagram and label**)

6. What is an ***enzyme*** and how does it speed up a chemical reaction?

7. What conditions affect the action of an enzyme (name three things)

8. What is the difference between a **prokaryotic** and **eukaryotic** cell? (Give an example of each type)

9. What are the roles of the **endoplasmic reticulum** and the **golgi apparatus** in the secretion of proteins?

10. What is the role of **mitochondria** in the cell?

11. What kind of cells might have a high number of **mitochondria**?

12. What are the four types of organic molecules found in living things?

13. Large macromolecules (polymers) are made (synthesized) from smaller building blocks called **monomers**. What are the building blocks for:

- Proteins-
- Carbohydrates-
- Nucleic Acids-

14. Proteins are all made from amino acids. What makes one **protein** different from another?

15. What effect does **temperature** have on **proteins**?

16. What **organelle** is responsible for **photosynthesis** and what is the name of the chemical (pigment) responsible for capturing the energy from sunlight?

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**Genetics**

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**BI2. Mutation and sexual reproduction lead to genetic variation in a population. As a basis for understanding this concept:**

**BI2. a.** *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.

**BI2. b.** *Students know* only certain cells in a multicellular organism undergo meiosis.

**BI2. c.** *Students know* how random chromosome segregation explains the probability that a particular allele will be in a gamete.

**BI2. d.** *Students know* new combinations of alleles may be generated in a zygote through the fusion of male and female gametes (fertilization).

**BI2. e.** *Students know* why approximately half of an individual's DNA sequence comes from each parent.

**BI2. f.** *Students know* the role of chromosomes in determining an individual's sex.

**BI2. g.** *Students know* how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents.

**BI3. A multicellular organism develops from a single zygote, and its phenotype depends on its genotype, which is established at fertilization. As a basis for understanding this concept:**

**BI3. a.** *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 or recessive).

**BI3. b.** *Students know* the genetic basis for Mendel's laws of segregation and independent assortment.

**BI4. 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. As a basis for understanding this concept:**

**BI4. a.** *Students know* the general pathway by which ribosomes synthesize proteins, using tRNAs to translate genetic information in mRNA.

**BI4. b.** *Students know* how to apply the genetic coding rules to predict the sequence of amino acids from a sequence of codons in RNA.

**BI4. c.** *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 an encoded protein.

**BI4. d.** *Students know* specialization of cells in multicellular organisms is usually due to different patterns of gene expression rather than to differences of the genes themselves.

**BI4. e.** *Students know* proteins can differ from one another in the number and sequence of amino acids.

**BI5. The genetic composition of cells can be altered by incorporation of exogenous DNA into the cells. As a basis for understanding this concept:**

**BI5. a.** *Students know* the general structures and functions of DNA, RNA, and protein.

**BI5. b.** *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.

**BI5. c.** *Students know* how genetic engineering (biotechnology) is used to produce novel biomedical and agricultural products.

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17. What is **mitosis** and what types of cells undergo mitosis?
18. What is the difference between **diploid** cells and **haploid** cells?
19. What **process** produces **diploid cells** and which produces **haploid cells**?
20. What is **meiosis** and what does it result in?
21. Explain why this is a good representation of **fertilization**:  $n + n = 2n$
22. What is meant by **segregation** when sex cells (gametes) are produced?
23. What is **independent assortment**?
24. What is a mutation?
25. **Mutations** may or may not affect the **expression** of a gene. Why?
26. What are **sex chromosomes** and what combinations would result in a boy or a girl?
27. What occurs during:
- **Replication-**
  - **Transcription-**
  - **Translation-**

28. What are the differences between **DNA** and **RNA** (name three)

29. What is a **codon** and how is it involved in protein synthesis?

30. During replication, the DNA sequence of **GTTACGCAT** would result in another strand have a sequence of?

31. During transcription, the DNA sequence of **GTTACGCAT** would result in a strand of RNA having a sequence of?

32. Use the table below to determine what **amino acid sequence** the following strands of **mRNA** would code for:

- **GGCAUACCC-**
- **UUCCAGUUA-**
- **GCATTACGG-**

What about a **DNA** sequence of:

- **GGCATACCC-**
- **UUCCAGTTA-**
- **GCATTACGG-**

**Codons Found in Messenger RNA**

		Second Base				
		U	C	A	G	
First Base U	U	Phe	Ser	Tyr	Cys	U
		Phe	Ser	Tyr	Cys	C
		Leu	Ser	Stop	Stop	A
		Leu	Ser	Stop	Trp	G
C	C	Leu	Pro	His	Arg	U
		Leu	Pro	His	Arg	C
		Leu	Pro	Gln	Arg	A
		Leu	Pro	Gln	Arg	G
A	A	Ile	Thr	Asn	Ser	U
		Ile	Thr	Asn	Ser	C
		Ile	Thr	Lys	Arg	A
		Met	Thr	Lys	Arg	G
G	G	Val	Ala	Asp	Gly	U
		Val	Ala	Asp	Gly	C
		Val	Ala	Glu	Gly	A
		Val	Ala	Glu	Gly	G

33. What are the **complementary bases** in DNA and in RNA?

- **DNA-**
- **RNA-**

34. Males are more likely to have a **sex-linked trait** than females. Why?

35. Why can a women be a carrier of a **sex-linked genetic** disorder but a male cannot?

35. What is crossing over? (Draw a diagram and explain)

36. Complete the following genetic cross and give the genotypic and phenotypic ratios of the offspring:  $Tt \times tt$  (draw punnett square and give ratios)

37. Complete the following genetic cross and give the genotypic and phenotypic ratios of the offspring:  $XX^h \times X^hY$  (draw punnett square and give ratios)

38. In fruit flies, the gene for red eyes (R) is dominant and the gene for sepia eyes (r) is recessive. What are the possible combinations of genes in the offspring of two red-eyed heterozygous flies (Rr)? (draw punnett square)

39. What is cloning?

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### Ecology

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**BI6.** **Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:**

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**BI6. a.** *Students know* biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.

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**BI6. b.** *Students know* how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.

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**BI6. c.** *Students know* how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.

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**BI6. d.** *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.

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**BI6. e.** *Students know* a vital part of an ecosystem is the stability of its producers and decomposers.

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**BI6. f.** *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.

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40. What does biodiversity mean?
41. How do alterations in a habit affect the biodiversity?
42. What are biotic and abiotic factors that effect an environment?
43. What are are the main **trophic levels** in a food chain or web? (Draw and label a diagram)
44. What is always forms the **base** of a **food chain** or **food web**?
45. What are the **four factors** that affect a **population size**?
46. What is **ecological succession** and what is the difference between **primary** and **secondary succession**?
47. What are **biogeochemical cycles**?
48. What are the two main processes that contribute to the **oxygen** and **carbon cycles**?
49. What is an **energy pyramid** and what percent of energy is available to each succeeding **trophic level**?
50. What is **carrying capacity**?
51. How does the burning of **fossil fuels** and **deforestation** effect the environment?
52. Why are **fungi** and **bacteria** so important and helpful in preventing the Earth from being covered with dead organisms?

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**Evolution**

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**BI7.**      **The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept:**

**BI7. a.**      *Students know why natural selection acts on the phenotype rather than the genotype of an organism.*

**BI7. b.**      *Students know why alleles that are lethal in a homozygous individual may be carried in a heterozygote and thus maintained in a gene pool.*

**BI7. c.**      *Students know new mutations are constantly being generated in a gene pool.*

**BI7. d.**      *Students know variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.*

**BI8.**      **Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept:**

**BI8. a.**      *Students know how natural selection determines the differential survival of groups of organisms.*

**BI8. b.**      *Students know a great diversity of species increases the chance that at least some organisms survive major changes in the environment.*

**BI8. c.**      *Students know the effects of genetic drift on the diversity of organisms in a population.*

**BI8. d.**      *Students know reproductive or geographic isolation affects speciation.*

**BI8. e.**      *Students know how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.*

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53. What is natural selection and why does **natural selection** act on **phenotypes** instead of **genotypes**?

54. Define the following terms:

- Species-
  
- Population-
  
- Community-
  
- Biome-

55. What type of **traits** might give an individual a greater chance of **surviving** (fitness)?

56. What type of **isolation** might lead to the development of a new species?

57. Define the following terms:

- ***Behavioral selection-***
- ***Disruptive selection-***
- ***Stabilizing selection-***
- ***Directional selection-***

58. What is **genetic drift** and when might it occur?

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**Physiology**

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**BI9.** As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment. As a basis for understanding this concept:

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**BI9. a.** *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.

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**BI9. b.** *Students know* how the nervous system mediates communication between different parts of the body and the body's interactions with the environment.

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**BI9. c.** *Students know* how feedback loops in the nervous and endocrine systems regulate conditions in the body.

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**BI9. d.** *Students know* the functions of the nervous system and the role of neurons in transmitting electrochemical impulses.

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**BI9. e.** *Students know* the roles of sensory neurons, interneurons, and motor neurons in sensation, thought, and response.

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**BI10.** Organisms have a variety of mechanisms to combat disease. As a basis for understanding the human immune response:

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**BI10. a.** *Students know* the role of the skin in providing nonspecific defenses against infection.

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**BI10. b.** *Students know* the role of antibodies in the body's response to infection.

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**BI10. c.** *Students know* how vaccination protects an individual from infectious diseases.

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**BI10. d.** *Students know* there are important differences between bacteria and viruses with respect to their requirements for growth and replication, the body's primary defenses against bacterial and viral infections, and effective treatments of these infections.

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**BI10. e.** *Students know* why an individual with a compromised immune system (for example, a person with AIDS) may be unable to fight off and survive infections by microorganisms that are usually benign.

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59. What is homeostasis?

60. How does a **nerve impulse** travel through the nervous system (describe an **electrochemical impulse**)

61. What is a **synapse** and how does the impulse travel across the synapse?

62. What is a **reflex arc**?

63. When you experience the "**fight or flight**" response, your adrenal glands secrete the hormone **adrenaline**. What is the result of this?

64. What is a **hormone**?

65. What is your body's **first line of defense** against pathogens?

66. How does the **HIV virus** reduce your ability to fight off infections?

67. How does your **circulatory** and **respiratory** systems work together to maintain **homeostasis**?

68. What **endocrine gland** and **hormone** it produces regulates **metabolism**?

69. What important function do your **kidneys** perform to maintain **homeostasis**?

70. How does a **vaccine** provide you with **immunity**?

71. Where does **chemical digestion** of food begin?
72. What type of **pathogens** do **antibiotics** work on or not work on?
73. What are your body's **non-specific defenses** against pathogens?
74. What are your body's **specific defenses** against pathogens?
75. What is an **antibody**?
76. What is an **antigen**?
77. What are the three types of **neurons**? (Diagram and label the correct pathway)
78. What is a **feedback loop** and how is it similar to a **thermostat** in your house?
79. How are the **nervous system** and **endocrine system** similar? Different?
80. Why is a **virus** not considered a living thing?