Practicing Biology Questions

Big Idea 3.A

1. Log onto http://www.bozemanscience.com/ap-biology/. Scroll down to "Big Idea 3: Information." Complete the video review activities listed below for videos #027 Part 1 and #027 Part 2 under Big Idea 3. REMEMBER, EACH NUMBERED COMPONENT SHOULD HAVE A DEDICATED PAGE (that is, summarize each video on a separate piece of paper):

a. Watch Bozeman Video #027: *DNA & RNA Part 1* – summarize key concepts and related illustrative examples in your own words. Support your understanding with diagrams when appropriate.

b. Watch Bozeman Video #027: *DNA & RNA Part 2* – summarize key concepts and related illustrative examples. In your own words. Support your understanding with diagrams when appropriate.

2. DNA and RNA molecules have structural similarities and differences that define function. Draw, label and describe the structure and function of DNA and RNA (3 types) including bonding mechanisms.

3. The proof that DNA is the carrier of genetic information involved a number of important historical experiments. Describe the contributions of the scientists below and outline their experimental questions, procedures, and results.

a. Contributions of Watson, Crick, Wilkins, and Franklin on the structure of DNA
b. Avery-MacLeod-McCarty experiments
c. Hershey-Chase experiment

4. Draw, label, and explain how DNA replicates. Your model or illustration and explanation should include the following:

a. The structure of a DNA double helix;
b. The antiparallel nature of the double helix;
c. The role of the following enzymes: DNA polymerase, ligase, helicase and topoisomerase;
d. The semiconservative replication process;
e. The leading/lagging strand replication.

5. Draw, label, and explain how proteins are built (*i.e.* protein synthesis). Your model or illustration and explanation should include the following:

a. The three main stages of transcription:
   i. Initiation;
   ii. Elongation;
   iii. Termination; and
   iv. The role of promoters and terminators
   v. mRNA modification before exiting nucleus
b. The three main stages of translation:
   i. Initiation;
   ii. Elongation;
   iii. Termination
   iv. The wobble effect
   v. The p site; A site; and E site

6. Describe two commonly used genetic technologies including how humans manipulate heritable information and the possible consequences. A labeled visual representation or model should accompany your description. You may choose from the following technologies: plasmid-based transformation, restriction enzyme analysis of DNA, or polymerase chain reaction (PCR) – information for these topics can be found in Ch. 20 of your AP Test Prep Series booklet.

Big Idea 3.A (continued)

7. Refer to textbook pages 316-318.
   a. What molecule is responsible for proofreading newly synthesized DNA?
   b. What occurs during a mismatch repair?
   c. How are errors that arise *after* DNA replication corrected? What is involved in this process?

8. Refer to textbook pages 318-319.
   a. Which part of a *eukaryotic* DNA molecule can DNA Polymerase NOT replicate? Explain why polymerase is unable to replicate this part.
   b. Does this phenomenon occur in prokaryotes? Why or why not?
   c. Describe in detail how eukaryotic cells address replicating the ends of their DNA molecules. You should include a discussion of the role of telomeres and telomerase here.
   d. How might normal shortening of telomeres protect an individual against cancer?
   e. How might normal shortening of telomeres be directly linked to the life span of an individual?

9. Refer to textbook pages 416-422.
   a. Discuss FOUR examples of the products of genetic engineering (GM foods, transgenic animals, cloned animals, pharmaceuticals such as human insulin, forensic evidence, environmental cleanup, agricultural applications).
   b. Discuss any ethical or health concerns that surround the use of EACH product discussed in part A.

10. Log onto http://www.bozemanscience.com/ap-biology/. Scroll down to "Big Idea 3: Information." Complete the video review activities listed below for videos #029 and #030 under Big Idea 3. REMEMBER, EACH NUMBERED COMPONENT SHOULD HAVE A DEDICATED PAGE (that is, summarize each video on a separate piece of paper):
   a. Watch Bozeman Video #029: *Mendelian Genetics* – summarize key concepts and related illustrative examples in your own words. Support your understanding with diagrams when appropriate.
   b. Watch Bozeman Video #030: *Advanced Genetics* – summarize key concepts and related illustrative examples. In your own words. Support your understanding with diagrams when appropriate.

11. Rules of probability can be applied to analyze passage of single gene traits from parent to offspring. Discuss the following:

a. The multiplication rule and when it would be used;
b. The rule of addition and when it would be used;
c. You can apply the multiplication and addition rules to predict the outcome of crosses involving multiple characters. Create your OWN trihybrid genetic cross and use the multiplication and addition rules to predict the outcomes of the cross. Show all work and calculations.

12. Use a model or visual representation to explain what aspects of meiosis account(s) for:

a. Mendel's law of segregation?
b. Mendel's law of independent assortment?

13. An individual is heterozygous for some genes and homozygous for other genes for 6 genes on separate pairs of homologous chromosomes. Their genotype is aaBbCcDDEeff. Given this information alone, how many different kinds of gametes could this individual produce if NO crossing over occurs? Show your work and calculations.

14. Consider the cross AaBbCcddEe x AABBccDDEe. Show your work and calculations for the following?

a. What is the probability that any offspring will have the genotype AaBBCcDdEE?
b. What is the probability that any offspring will have the genotype AABBCCDDee?

15. In fruit flies (*Drosophila melanogaster*), the most common eye color is red. A mutation (or allele) of the gene for eye color produces white eyes. The gene is located on the X chromosome.

a. What is the probability that a heterozygous red-eyed female fruit fly mated with a white-eyed male will produce any white-eyed offspring? Show your work and calculations.
b. What is the probability that the mating in part a will produce any white-eyed females? Show your work and calculations.
c. What is the probability that this mating will produce any white-eyed males? Show your work and calculations.

16. Create a linkage map of the relative location of the following four genes on a chromosome based on their crossover frequencies. Justify your answer.

- X and Z = 5%
- Y and W = 15%
- W and X = 30%
- Y and X = 45%
- Y and Z = 50%

17. Three new traits have been discovered in a population of *Drosophila*: (I) Tapping; (II) Single Stripe; and (III) Angular Bristles. The positions of the three genes on the chromosomes are unknown. Given two pure breeding (homozygous) lines and using an initial cross of normal, normal, normal females with tapping, single stripe, angular males, describe the appropriate genetic experiments needed to establish whether any of these traits are caused by genes that are:

i. Autosomal or sex-linked
ii. Linked on the same chromosome or unlinked

18. A newly identified fruit fly mutant, cyclops eye (large and single in the middle of the head), is hypothesized to be autosomal dominant. The experimenter started with homozygous wild type females (yes, virgins) and homozygous cyclops males. The data from the F_2 generation was 44 wild type males, 60 wild type females, 110 cyclops males and 150 cyclops females. Does this data support or reject the hypothesis? Use chi square to justify your position. Show your work and calculations

Chi-Square Table

	Degrees of Freedom							
p	1	2	3	4	5	6	7	8
0.05	3.84	5.99	7.82	9.49	11.07	12.59	14.07	15.51
0.01	6.64	9.32	11.34	13.28	15.09	16.81	18.48	20.09

19. Certain human genetic disorders can be attributed to the inheritance of single gene traits or specific chromosomal changes, such as nondisjunction. Describe how the following inheritance patterns deviate from expected Mendelian outcomes:

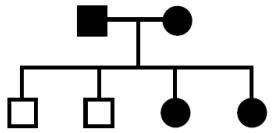
a. Huntingon's disease;
b. Colorblindness
c. Sickle Cell Animia
d. Klinefelter's Syndrome

20. Many ethical, social and medical issues surround human genetic disorders. Illustrate your understanding of this concept by discussing:

a. Reproduction issues; and
b. Civic issues such as ownership of genetic information, privacy, and historical contexts.

21. Discuss some examples of traits that are passed from parent to offspring via nonnuclear inheritance patters such as mitochondrial DNA.

22. Review the following pedigree. Use simple Punnett squares to determine if this trait could be inherited as:



Could this trait be inherited as a simple…

			If "**YES**", then suggested genotypes of **father** **mother**
a. autosomal recessive?	**YES**	**NO**	_____ x _____
b. autosomal dominant?	**YES**	**NO**	_____ x _____
c. X-linked recessive?	**YES**	**NO**	_____ x _____
d. X-linked dominant?	**YES**	**NO**	_____ x _____
e. Y-linked trait?	**YES**	**NO**	_____ x _____

Big Idea 3.B

23. Log onto http://www.bozemanscience.com/ap-biology/. Scroll down to "Big Idea 3: Information." Complete the video review activities listed below for videos #031 and #032 under Big Idea 3 and #024 under Big Idea 2. REMEMBER, EACH NUMBERED COMPONENT SHOULD HAVE A DEDICATED PAGE (that is, summarize each video on a separate piece of paper):

a. Watch Bozeman Video #031: *Gene Regulation* – summarize key concepts and related illustrative examples in your own words. Support your understanding with diagrams when appropriate.
b. Watch Bozeman Video #032: *Signal Transmission* – summarize key concepts and related illustrative examples. In your own words. Support your understanding with diagrams when appropriate.
c. Watch Bozeman Video #024: *Development-Timing & Coordination* – summarize key concepts and related illustrative examples. In your own words. Support your understanding with diagrams when appropriate.

24. Draw, label and describe the function of the *trp* and *lac* operons used by bacteria for gene regulation.

25. Using appropriate cellular, organismal, and population-level examples, explain how gene regulation allows for cell specialization and efficient cell function. Predict how changes in gene regulation will affect cellular functions using an appropriate illustrative example.

26. Using appropriate examples, predict how changes in signal transduction pathways will affect specific cellular processes and responses for both bacteria and eukaryotes.

27. Explain how the types of mutations that lead to cancer are different for a proto-oncogene and a tumor-suppressor gene, in terms of the effect of the mutation on the activity of the gene product.

28. As you learned in Ch. 12, mitosis gives rise to two daughter cells that are genetically identical to the parent cell. Yet you, the product of many mitotic divisions, are not composed of identical cells. Why?

29. The signaling molecules released by an embryonic cell can induce changes in a neighboring cell without entering the cell. How? Use an appropriate model or diagram to accompany your discussion.

30. Describe the role of homeotic genes in the key developmental events in the life cycle of *Drosophila*. A model or diagram should accompany your description of both homeotic genes and *HOX* genes.

31. After reading "Coupling Transcriptional and Post-Transcriptional miRNA Regulation in the Control of Cell Fate", summarize your understanding of the role of small non-coding RNAs in gene expression. Your summary should refer to ***specific*** examples from the article.

32. Discuss the role of apoptosis in *C. elegans* development.

33. Connect concepts in and across domains to describe how timing and coordination of specific events are necessary for normal development in an organism, describe how these events are regulated by multiple mechanisms (*i.e.,* homeotic genes, environmental factors, embryonic induction, role of microRNAs), and predict consequences in alterations in mechanisms necessary for normal development (*i.e.,* genetic mutation, mutations of transcription factors, etc.). Models or visual representations should accompany major concepts.

Big Idea 3.C

34. Log onto http://www.bozemanscience.com/ap-biology/. Scroll down to "Big Idea 3: Information." Complete the video review activities listed below for videos #033, #034, and #035 under Big Idea 3. REMEMBER, EACH NUMBERED COMPONENT SHOULD HAVE A DEDICATED PAGE (that is, summarize each video on a separate piece of paper):

a. Watch Bozeman Video #033: *Genotypes & Phenotypes* summarize key concepts and related illustrative examples in your own words. Support your understanding with diagrams when appropriate.
b. Watch Bozeman Video #034: *Increasing Genetic Variation* – summarize key concepts and related illustrative examples. In your own words. Support your understanding with diagrams when appropriate.
c. Watch Bozeman Video #035: *Viral Replication* – summarize key concepts and related illustrative examples. In your own words. Support your understanding with diagrams when appropriate.

35. Predict how various types of change in a DNA sequence can alter a phenotype, and describe several using real-world examples.

36. Predict possible effects that alterations in the normal process of meiosis will have on the phenotypes of offspring compared to the normal situation and connect the outcomes to issues surrounding human genetic diseases, chromosome structure, gamete viability, genetic diversity, and evolution. Justify your explanation.

37. Justify how various molecular, cellular, and organismal processes in bacteria and eukaryotes increase genetic variation in a population and allow for natural selection.

38. Explain why viruses must invade other cells in order to reproduce. Include a description of the lytic and lysogenic cycles. Your answer should include a diagram of the cycles.

39. Using specific examples, justify how the life cycles of DNA and RNA viruses can contribute to rapid evolution of both the virus and the host.

Big Idea 3.D

40. Log onto http://www.bozemanscience.com/ap-biology/. Scroll down to "Big Idea 3: Information." Complete the video review activities listed below for videos #036, #037, #038, and #039 under Big Idea 3. REMEMBER, EACH NUMBERED COMPONENT SHOULD HAVE A DEDICATED PAGE (that is, summarize each video on a separate piece of paper):

a. Watch Bozeman Video #036: *Evolution of Cell Communication* - summarize key concepts and related illustrative examples in your own words. Support your understanding with diagrams when appropriate.
b. Watch Bozeman Video #037: *Cell Communication* – summarize key concepts and related illustrative examples. In your own words. Support your understanding with diagrams when appropriate.
c. Watch Bozeman Video #038: *Signal Transduction in Pathways* – summarize key concepts and related illustrative examples. In your own words. Support your understanding with diagrams when appropriate.
d. Watch Bozeman Video #035: *Effects of Changes in Pathways* – summarize key concepts and related illustrative examples. In your own words. Support your understanding with diagrams when appropriate.

41. Justify how the mechanics of cell-to-cell communication support common lines of evolutionary descent. Provide specific examples that illustrate common ancestry and pose scientific questions that test the justification rationale.

42. Using appropriate examples from *plants, animals, AND bacteria*, justify how the features of cell-to-cell contact and the use of chemical signals allow communication over *short AND long distances*.

43. Construct a model that illustrates how chemical signals can alter cellular responses. Describe/explain your model.

44. Describe the following cell signaling models: G-Protein; Tyrosine Kinase; and Ion Channel.

45. Using one illustrative example, describe how certain drugs target specific signal transduction pathways and alter cellular response. Examples of drugs include medications for hypertension, anesthetics, antihistamines, and birth control pills.

Big Idea 3.E

46. Log onto http://www.bozemanscience.com/ap-biology/. Scroll down to "Big Idea 3: Information." Complete the video review activities listed below for videos #040 and #041 under Big Idea 3. REMEMBER, EACH NUMBERED COMPONENT SHOULD HAVE A DEDICATED PAGE (that is, summarize each video on a separate piece of paper):

a. Watch Bozeman Video #040: *Information Exchange* - summarize key concepts and related illustrative examples in your own words. Support your understanding with diagrams when appropriate.
b. Watch Bozeman Video #037: *The Nervous System* – summarize key concepts and related illustrative examples. In your own words. Support your understanding with diagrams when appropriate.

47. Justify how changes in internal or external clues affect the behavior of individuals and their interactions within a population and between related individuals.

48. Draw, label and describe a neuron cell. Discuss how structure is related to function. Provide several examples.

49. Describe, using an illustrated model, how action potentials propagate impulses along neurons.

50. Describe how the nervous system detects external and internal stimuli and transmits signals along AND between nerve cells.

51. Provide examples that illustrate your understanding of how different regions of the vertebrate brain have different functions.