Name: Period:

AP Biology Final Study Guide

This study guide highlights concepts and terms covered in the genetics unit. While this study guide is meant to be inclusive, any term or concept covered in homework and classwork is fair game. You will NOT be allowed to use any form of notes on this exam.

This study guide is meant to *guide your studying*; it is not an assignment to be turned in. To get the most out of this tool, here are my recommendations:

- Read through all terms and concepts and check off the ones you could explain aloud immediately. This will help ensure you are studying smart and not unnecessarily long. Over-studying can increase anxiety and reduce test performance.
- For the terms and concepts you could not immediately explain aloud, make a flash card for them. Review your flashcards at regular intervals.
- For each lesson topic, design a thought web or concept map of how they are related.
- Once you have a thought web for each topic, see what connections you can make across lessons.
- After mapping out your ideas and with your webs in front of you, begin asking yourself questions. For example “how could water potential affect the opening and closing of stomata?” AP test questions are designed in this manner; writers look at the content standards and try and ask you questions that get you to bridge knowledge you learned in different areas. Try and think like a test developer.

- Re-attempt problems (especially any you got incorrect) from the practice packets and quizzes.
- Look-up AP Biology “released free response” and the “scoring guidelines” from 2012 or later. Practice relevant problems.
- Complete the additional practice problems at the end of this packet.
- For any material you need re-lectured, check out Crash Course Biology and Kahn academy on Youtube or come to a review session PREPARED with questions:

Simply memorizing terms and concepts will not guarantee you a great score on the exam. You will need to apply your reasoning and your knowledge together.

DNA

5’ 3’ Antiparallel Avery, McCarty, McCleod Experiment Chargaff’s Rules	DNA ligase DNA polymerase Frederick Griffith gene Experiment Helicase Hershey Chase Experiment	lagging strand leading strand Mutation purine pyrimidine DNA polymerase gel electrophoresis	Okazaki fragment replication fork restriction digest restriction enzyme restriction site transformation	semiconservative replication Single stranded binding proteins Watson, Crick, Franklin and Wilkins Experiment

Study Prompts

1. What is the end product of DNA replication? In which cell cycle stage is DNA replicated?
2. Describe the steps of DNA replication. Explain why it is considered semiconservative?
3. How is a DNA double helix antiparallel?
4. Describe the differences between the leading strand and the lagging strand.
5. How do bacteria gain genetic variation? How are plasmids involved?*
6. How are bacteria used in biotechnology? plasmids? viruses? *
7. How does gel electrophoresis work?*
8. Be able to read a gel electrophoresis result to determine size of fragment, electronegativity, and number of fragments.*
9. Explain how a recombinant DNA/plasmid is formed. What are the benefits of making recombinant DNA?*
10. How does a restriction enzyme work?*
11. Why do we cut both plasmids (in lab) with the same restriction enzymes?*
12. What is the importance of using bacteria that carry a known resistance gene?*
13. Explain the uses of gel electrophoresis.*

* ONLY IF WE DO THE LAB BEFORE THE EXAM

Gene Expression

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anticodon	intron	Nonsense	regulatory gene	rRNA
codon	mG cap	mutation	repressor	Silent mutation
enhancer	mRNA	repressible	reverse	transcription
epigenetics	microRNA	operon	transcription	factor
exon	missense	point mutation	RNA interference	transcription
frameshift	mutation	poly-A tail	RNA polymerase	translation
mutation	operator	Promoter	RNA processing	tRNA
Histone	inducible operon	splicing		

Study Prompts

1. Protein synthesis occurs in two stages: transcription and translation. State the purpose of each.
2. Why must the genetic code be written in triplets of nucleotides?
3. Describe the relationship between a DNA triplet, a codon, and an anticodon.
4. What is the evolutionary significance of the genetic code?
5. Briefly outline the process of transcription. Compare it to and contrast it with DNA replication.
6. Why are the ends of an mRNA altered?
7. State the purpose of transcription and where it takes place. Briefly describe the process, including initiation, elongation and termination.
8. What is the difference between the RNA transcript and the mRNA strand?
9. What is splicing and its purpose? When does it take place?
10. Why do you think it is more important for DNA polymerase than for RNA polymerase to proofread?
11. How does the change in genotype lead to a change in phenotype?
12. Describe the roles of mRNA and the codon.
13. State the purpose of translation and where it takes place. Briefly describe the process, including initiation, elongation and termination.
14. Describe the different base substitution mutations and the results of each.
15. What is a frameshift mutation and how does it affect the outcome of the protein?
16. Is the result of a point or frameshift mutation more harmful to the organism? Explain how.
17. In what ways are mutations helpful, harmful or have no effect? Give specific examples.
18. In what way does protein synthesis ensure that the protein is correctly made?
19. Describe the basic concept of the operon, including the role of each of the following: promoter, regulatory gene, operator, genes, repressor
20. Explain the difference between how an inducible operon and a repressible operon turn the gene on or off.
21. Why do prokaryotic cells turn genes on/off?
22. What role does gene regulation (on/off) have in eukaryotic cells?

Cell Cycle

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gene P53 tetrad anaphase benign tumor centromere cyclins cytokinesis diploid cell DNA ligase	fertilization haploid cell helicase interphase Kinetochore metaphase metastasis mutation	prophase purine pyrimidine somatic cell spindle fibers Telophase malignant tumor Okazaki fragment non-disjunction replication fork	sister chromatids asexual reproduction anchorage dependence cell cycle control system Crossing-over density-dependent inhibition	homologous chromosomes semiconservative replication sexual reproduction

1. What is the function of the Cell Cycle?
2. Draw the stages of the cell cycle and write what happens at each stage.
3. What is the importance of the metaphase checkpoint? How does this relate to non-disjunction?
4. What is Cancer? What are the types of cancerous cells?
5. Why don't some cells divide? Explain how they spend their time in the cell cycle.
6. Why do the chromosomes condense into rod-like structures during cell division?
7. Explain the difference between homologous chromosomes & sister chromatids.
8. At which point does a cell have double its normal number of chromosomes? What is the purpose of this?
9. In organisms that reproduce sexually, why do chromosomes come in pairs?
10. Differentiate between homologous chromosomes and sister chromatids.
11. Explain how asexual and sexual reproduction differ.
12. How is sexual reproduction advantageous over asexual reproduction? asexual reproduction over sexual?
13. Describe how diploid and haploid cells differ from another.
14. Why is it necessary for gametes to have half the number of chromosomes as somatic cells?
15. What are three differences between mitosis and meiosis?
16. What is the difference between Meiosis 1 & Meiosis 2?
17. How does sexual reproduction contribute to genetic variation?

Inheritance

Allele Centimorgan Centrioles Codominance Crossing Over Dihybrid Cross	Dominant Gene Genomic Imprinting Genotype Heterozygous	Homozygous Incomplete dominance Independent Assortment Linked Genes Maternal	Monohybrid Cross Multiple Alleles Nondisjunction Paternal Pedigree Phenotype	Pleiotropy Polygenic Recessive Sex-linked Spindle Fibers

Study Prompts

1. Explain the difference between each type of non-mendelian inheritance and traditional mendelian principles of inheritance.
2. Explain how meiosis and sexual reproduction increase genetic variation.
3. How does environment influence phenotype?
4. What is the difference between incomplete dominance and polygenic inheritance?
5. How does percent recombination correlate to the location of genes on chromosomes?

Practice Problems

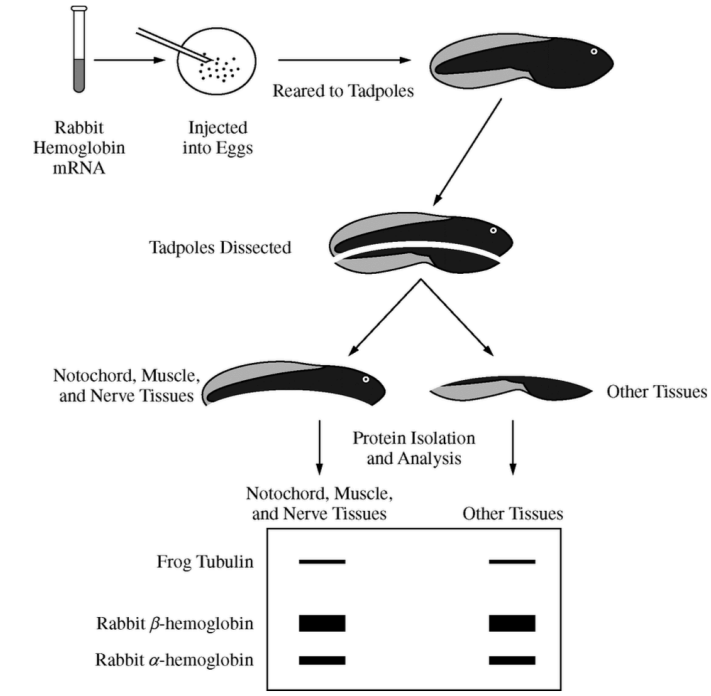
1. Rosalind Franklin's x-ray diffraction images taken in the 1950s most directly support which of the following claims about DNA?

(A) The ratios of base pairs are constant.
(B) The nucleotide sequence determines genetic information.
(C) The two strands of DNA are antiparallel.
(D) The basic molecular structure is a helix.

2. A new mutation that arose in one copy of gene X in a somatic cell resulted in the formation of a tumor. Which of the following pieces of evidence best describes how the new mutation directly caused the tumor?

(A) Protein X normally stimulates cell division, and the mutation created an overactive version of protein X.
(B) Protein X normally activates a growth hormone receptor, and the mutation decreased the stability of protein X.
(C) Protein X normally prevents passage through the cell cycle, and the mutation created an overactive version of protein X.
(D) Protein X normally regulates gene expression, and the mutation created an underactive version of protein X that blocked the cell cycle.

Questions 3-7



In a classic experiment from the 1970s investigating gene expression, a solution containing equal amounts of rabbit a-hemoglobin mRNA and b-hemoglobin mRNA, which encode subunits of a protein found in red blood cells, was injected into newly fertilized frog eggs. The injected mRNA was not degraded during the course of the experiment. Tadpoles that developed from the injected eggs were dissected into two fragments, one containing predominantly the notochord, muscle tissue, and nerve tissue and the other containing predominantly the other tissue types.

Equal amounts of total protein were analyzed after separation by electrophoresis to identify the relative amounts of the different proteins present in each sample. The thickness of the bands indicates the relative amounts of rabbit a-hemoglobin, rabbit b-hemoglobin, and frog tubulin (a cytoskeletal protein that is expressed at relatively constant levels in all tissues) present in each tadpole sample. The experimental protocol and results are summarized in the figure below.

3. The observation that the rabbit mRNA was successfully translated in the frog tissues supports which of the following conclusions?

(A) Frog cells are able to replace their own hemoglobin with rabbit hemoglobin.
(B) Undeveloped frog eggs can be induced to form genetically identical copies of a rabbit.
(C) Rabbit hemoglobin can induce an immune response in frogs.
(D) Rabbits and frogs share a common genetic code for expressing heritable information.

4. The electrophoresis results best support which of the following conclusions?

(A) Cell specialization during development results in some cells losing the ability to synthesize proteins.
(B) Cells from different tissues share a common ability to use genetic material from a foreign source to produce protein.
(C) In comparison with other cells, nerve cells have a superior ability to produce cytoskeletal proteins.
(D) Muscle cells produce more b-hemoglobin than do cells from the other tissues in a tadpole.

5. Which of the following is the best justification for why the rabbit hemoglobin proteins were found throughout the tadpole?

(A) Rabbit mRNA is composed of nucleotides that are more stable than those in frog mRNA.
(B) Rabbit hemoglobin is synthesized more efficiently than frog hemoglobin in frog cells.
(C) After differentiation, the rabbit hemoglobin proteins move through the circulatory system of the tadpole to every cell.
(D) The mRNA injected into the newly fertilized frog eggs is distributed in the cytoplasm of every daughter cell during cell division.

6. Which of the following conclusions is most consistent with the results of the experiment?

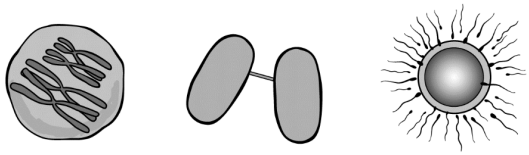
(A) Rabbit mRNA is composed of nucleotides that are absent from frog mRNA.
(B) A larger volume of blood circulates through a rabbit than through a frog.
(C) The subunits of hemoglobin differ in size, shape, or charge.
(D) Synthesis of b-hemoglobin occurs at a faster rate in muscle cells than in other body cells.

7. Given that equal amounts of the different mRNAs were injected into fertilized frog eggs, which of the following conclusions is most consistent with the electrophoresis results?

(A) b-hemoglobin mRNA is translated more efficiently than is a-hemoglobin mRNA.
(B) a-hemoglobin is present only in cells where b-hemoglobin is absent.
(C) a-hemoglobin mRNA is more stable than b-hemoglobin mRNA.
(D) Tubulin inhibits translation of hemoglobin mRNA.

8. If chemical signals in the cytoplasm control the progression of a cell to the M phase of the cell cycle, then fusion of a cell in G1 with a cell in early M phase would most likely result in the

(A) replication of chromosomes only in the G1 cell
(B) exiting of both cells from the cell cycle and into the G0 phase
(C) condensation of chromatin in preparation of nuclear division in both cells
(D) transfer of organelles from the G1 cell to the cell in the M phase



Crossing Over Conjugation Fertilization

9. The processes illustrated in the models depicted above all result in which of the following?

(A) Transcription
(B) An increase in genetic variation
(C) An increase in the chromosome number
(D) Horizontal gene transfer

Nervous System

- Neuron
- Sensory Neuron
- Interneuron
- Motor Neuron
- *Synapse*
- Dendrite
- Cell Body
- Axon
- Myelin
- Schwann Cell
- Nodes of Ranvier
- *Axon terminal*
- *Polarized*
- *Depolarization*
- *Action Potential*
- *Neurotransmitter*
- *Ligand-gated ion channel*
- Central Nervous System
- Peripheral Nervous System
- *Sodium-Potassium Pump*

Be able to explain...

- Why animals evolved nervous systems
- The charge difference across a neuron cell membrane at rest
- The process of depolarization
- What initiates the propagation of an action potential
- The sequence of of an actional potential
- The steps of neurotransmitter release
- The importance of protein pumps, concentration gradients and active transport in establishing action potentials
- The processing of a reflex and its evolutionary advantage

Endocrine System

- *Reception*
- *Transduction*
- *Response*
- *Ligand*
- Paracrine signaling
- Synaptic signaling
- *Polypeptide Hormones (water soluble)*
- *Steroid Hormones (lipid soluble)*
- *Positive Feedback Loop*

- *Negative Feedback Loop*
- Endocrine disruptor

Be able to explain…

- The three stages of cell signaling
- The logic behind the necessity of local signaling and long distance signaling
- The amplification of the cell signal cascade
- The differences of nervous system signaling and endocrine system signaling
- An example of a positive feedback loop
- An example of a negative feedback loop
- How endocrine disruptors negatively impact human health
- An ethical concern or question regarding endocrine disruptors

<u>Immune System</u>

- *Innate immunity*
- *Adaptive immunity*
- Lymphatic system
- Nonspecific external defenses
- Skin
- Mucus
- Ciliated epithelium
- Non-specific internal defenses
- Phagocytes
- Inflammatory response
- *Plasma B Cells*
- *Memory B Cells*
- *Cytotoxic T Cells*
- *Memory T Cells*
- *Helper T Cells*
- *Antibodies*
- *Antigens*
- Clonal Selection
- Opsonization
- Neutralization
- Complement Activation
- *Primary Response*
- *Secondary Response*
- MHC Complex
- Perforin
- Virus

Be able to explain...

- The differences between innate and adaptive immunity

- The differences of the primary versus secondary responses
- How vaccines confer immunity
- How scientists are manipulating the human immune system to cure cancer

Circulatory System

- Atrium
- Ventricle
- Vein
- Artery
- Capillaries
- *Pulmonary Vein*
- *Pulmonary Artery*

Be able to explain...

- The pathway of blood through the body
- The differences between arteries and veins
- How pulmonary veins and arteries differ from other veins and arteries
- The evolutionary advantage of a four chambered heart

Respiratory

- *Alveoli*
- Diaphragm
- *Hemoglobin*
- *Myoglobin*

Be able to explain…

- How the respiratory helps the body maintain homeostasis
- The importance of mucus and cilia

Old But Important:

Diffusion and Osmosis

- Cell Membrane
- Phospholipid Bilayer
- Hydrophobic
- Hydrophilic
- Transport Proteins
- Polar
- Nonpolar
- Selective Permeability
- Hypertonic
- Hypotonic
- Water Potential

- Concentration Gradient
- Active Transport
- Passive Transport
- Endocytosis
- Exocytosis

Be able to…

- Explain the diffusion of ions across the neuronal membrane
- Identify active and passive transport
- Explain the diffusion of gases across alveoli