AP Biology - Unit 1 - Biochemistry Review - pages 1-4

Part 1 - Review the Basics

Use complete sentences to answer the following questions. These questions are based on prior Biology 1 knowledge.

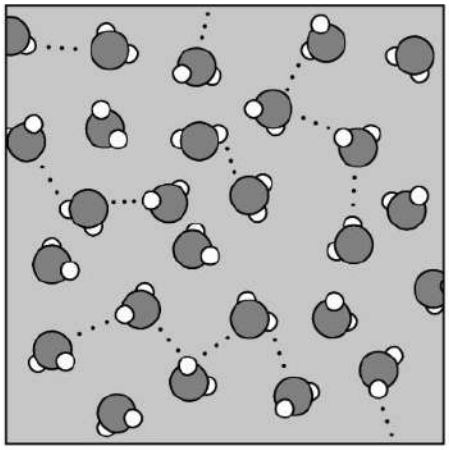
1) What does it mean when water is described as "polar?"
2) Compare and contrast: covalent bonds, ionic bonds, and hydrogen bonds
3) What six elements make up the majority of an organism?
4) Carbohydrates, lipids, proteins, and nucleic acids are the four major macromolecules that make up most living things. For each of the four macromolecules, list:
    a) the elements they are usually composed of
    b) the monomers that make up each macromolecule
    c) the function of the macromolecule in an organism
    d) an example of the macromolecule
5) Compare and contrast the structure of DNA and RNA. Provide at least three similarities and three differences.

Part 2 - AP Biology Review

Use complete sentences to answer the following questions. You may use your textbook, old homework assignments, vocabulary review, etc. to help answer the questions.

1.1 - Structure of Water and Hydrogen Bonding

1) Water's polarity allows it to form hydrogen bonds. Provide at least THREE examples of how water's hydrogen bonding is necessary for organisms to survive.
2) How does the difference in the electronegativities of hydrogen and oxygen lead to the polarity of a water molecule?



Liquid Water

1.2 - Elements of Life

3) What property of carbon allows it to be the "backbone" of all macromolecules?
4) How does the carbon cycle help make carbon available to organisms?
5) Contrast how plants and animals acquire the nitrogen they need to survive.

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1.3 - Introduction to Biological Macromolecule

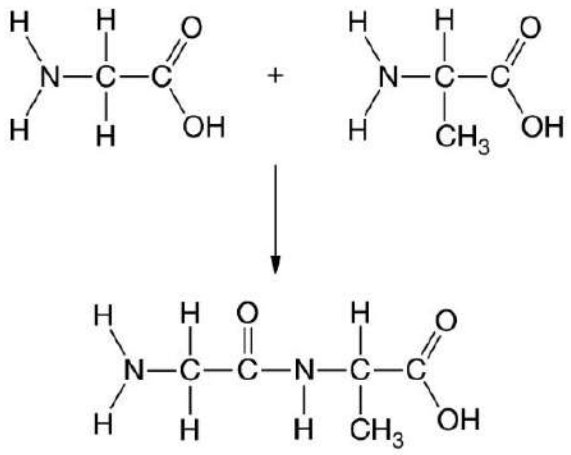


Figure 1. Formation of a peptide bond

6) Using the diagram above as an example, explain the process of “dehydration synthesis.”

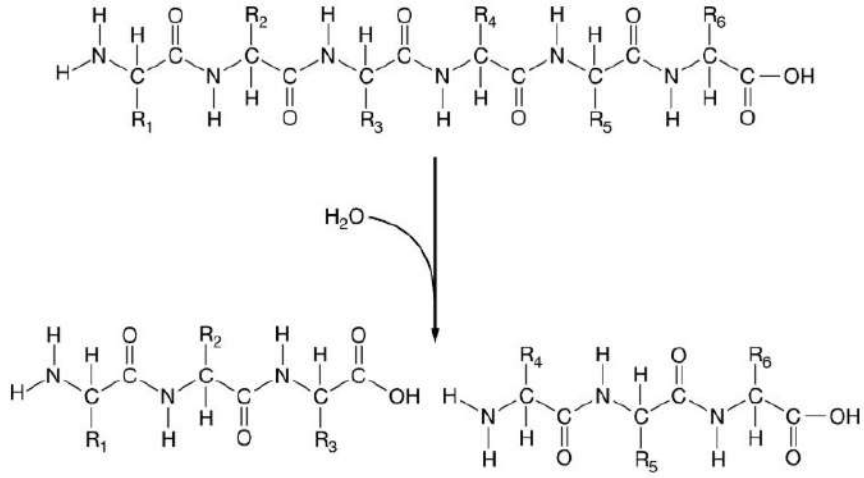


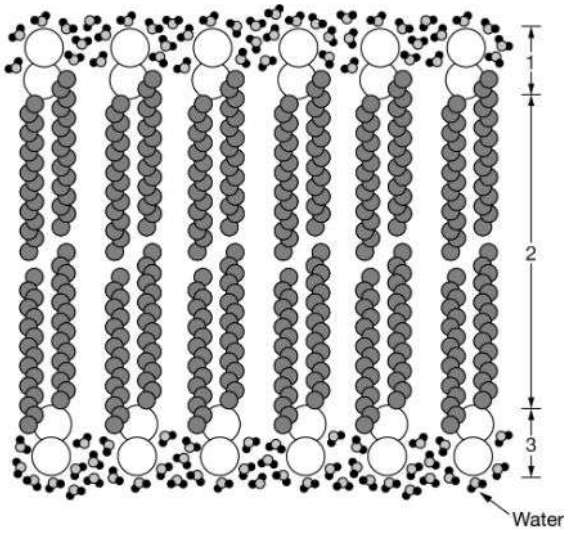
Figure 1. Polypeptide reaction

7) Using the diagram above as an example, explain the process of “hydrolysis.”

1.4 - Properties of Biological Macromolecules

8) Considering the chemical differences between carbohydrates and lipids, explain:
    a) Their use as chemical energy
    b) Their ability to form structures in cells

AP Biology - Unit 1 - Biochemistry Review - pages 1-4



9) What does it mean when a phospholipid is described as being “amphipathic?” The above diagram might help.

1.5 - Structure and Function of Biological Macromolecules

10) What is the significance of an “R group” in an amino acid?

11) Describe each of the following levels of protein structure:

   a) primary structure

   b) secondary structure

   c) tertiary structure

   d) quaternary structure

1.6 - Nucleic Acids

12) What is the basic structure of a nucleotide?

13) What are the rules of base pairing? Use the terms *purine* and *pyrimidine* in your answer.

14) Why does the order of bases in a nucleic acid matter?

15) What does it mean when two strands of DNA are described as “antiparallel?” Use the terms *5’* and *3’* in your answer.

AP Biology - Unit 1 - Biochemistry Review - pages 1-4

16) Using your knowledge of DNA, explain the significance of the data of Erwin Chargaff as shown in the table below.

Table 1. Nucleotide composition of sample DNA from selected organisms

Organism	Relative Amounts of Bases					
	%A	%G	%C	%T	% (G+C)	%(A + T)
Octopus	33.2	17.6	17.6	31.6	35.2	64.8
Chicken	28.0	22.0	21.6	28.4	43.7	56.4
Rat	28.6	21.4	20.5	28.4	42.9	56.0
Grasshopper	29.3	20.5	20.7	29.3	41.2	58.6
Wheat	27.3	22.7	22.8	27.1	45.5	54.4

AP Biology - Unit 2 - Cell Structure and Function - pages 5-10

Part 1 - Review the Basics

Use complete sentences to answer the following questions. These questions are based on prior Biology 1 knowledge.

1) The cell is the basic unit of life. Cells contribute to the organization of life and provide the environment in which organelles function. Not all cells are the same. Briefly describe how the function of organelles within a cell determines the function of that cell.

Part 2 - AP Biology Review

Use complete sentences to answer the following questions. You may use your textbook, old homework assignments, vocabulary review, etc. to help answer the questions.

2.1 - Cell Structure: Subcellular Components

1. Describe the structure and function of the following: Ribosomes, Endoplasmic Reticulum(rough and smooth), Golgi complex, Mitochondria, Lysosomes, Vacuoles, and Chloroplasts. Do not give analogies(ie. Protein factory, powerhouse), describe the actual function.

2.2 - Cell Structure and Function

2. Explain how the double membrane within Mitochondria and Chloroplasts help with their functions of metabolic reactions (Cellular Respiration, and Photosynthesis). Include why increased surface area is important within both organelles.

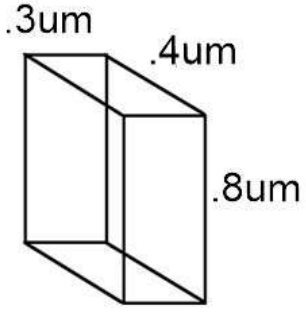
2.3 - Cell Size

3. Why are cells so small?

a) Compare surface area to volume of a cell. What happens to volume when surface area increases.

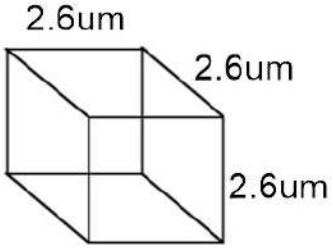
b) What can cells do to help increase surface area and/or decrease volume?

c) Calculate surface area, volume and the surface area : volume ratio for a rectangular solid

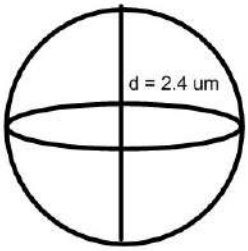


AP Biology - Unit 2 - Cell Structure and Function - pages 5-10

d) Calculate surface area, volume and the surface area : volume ratio for a cube

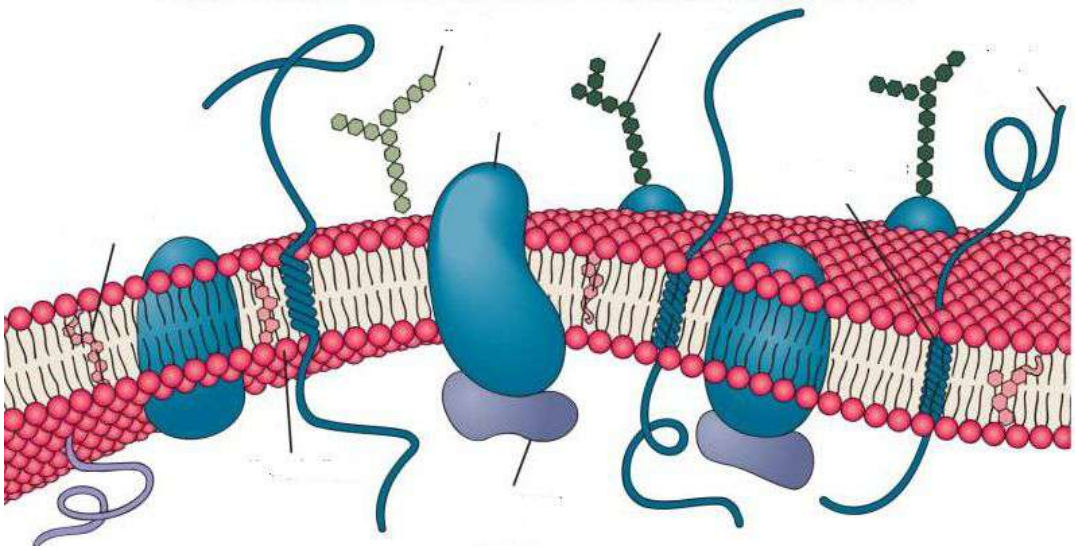


e) Calculate surface area, volume and the surface area : volume ratio for a sphere



2.4 - Plasma Membrane

4. Label the following structures in the plasma membrane below: glycoprotein, glycolipid, phospholipids, protein, cholesterol.



5. Label the hydrophilic heads in the diagram above. Explain the orientation of the heads in relation to the plasma membrane.

6. Label the hydrophobic fatty acid tails in the diagram above. Explain the orientation of the tails in relationship to the plasma membrane.

AP Biology - Unit 2 - Cell Structure and Function - pages 5-10

7. Explain the role each component of the cell membrane has to the functioning of the cell.

Cell membrane structure	Role/function
Phospholipid	
protein	
cholesterol	
glycoprotein	
glycolipid	

2.5 - Membrane Permeability

8. Explain why the plasma membrane is considered selectively permeable.

9. Explain how the structure of a molecule affects its ability to pass through the plasma membrane.

10. How does Polarity play a role in movement of molecules through the membrane?

11. Cell Walls also have permeability, what are some differences in cell wall composition from Plants, Prokaryotes, and Fungi?

2.6 - Membrane Transport

12. Identify the two types of passive transport and state which part of the plasma membrane is used for each type of transport.

13. Describe the type of molecules that are able to pass through the cell membrane by simple diffusion and give examples.

2.7 - Facilitated Diffusion

14. Describe the type of molecules that are able to pass through the cell membrane by facilitated diffusion and give examples.

15. Describe how aquaporins work to all for water movement through cell walls.

AP Biology - Unit 2 - Cell Structure and Function - pages 5-10

2.8 - Tonicity and Osmoregulation

AP® BIOLOGY EQUATIONS AND FORMULAS

Statistical Analysis and Probability

Mean

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

Standard Deviation *

$$s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$$

Standard Error of the Mean *

$$SE_{\bar{x}} = \frac{s}{\sqrt{n}}$$

Chi-Square

$$\chi^2 = \sum \frac{(o-e)^2}{e}$$

Chi-Square Table

p value	Degrees of Freedom							
	1	2	3	4	5	6	7	8
0.05	3.84	5.99	7.81	9.49	11.07	12.59	14.07	15.51
0.01	6.63	9.21	11.34	13.28	15.09	16.81	18.48	20.09

$\bar{x}$ = sample mean

n = sample size

s = sample standard deviation (i.e., the sample-based estimate of the standard deviation of the population)

o = observed results

e = expected results

Σ = sum of all

Degrees of freedom are equal to the number of distinct possible outcomes minus one.

Laws of Probability

If A and B are mutually exclusive, then:

$$P(\text{A or B}) = P(\text{A}) + P(\text{B})$$

If A and B are independent, then:

$$P(\text{A and B}) = P(\text{A}) \times P(\text{B})$$

Hardy-Weinberg Equations

$p^2 + 2pq + q^2 = 1$

$p + q = 1$

p = frequency of allele 1 in a population

q = frequency of allele 2 in a population

Metric Prefixes

Factor	Prefix	Symbol
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

Mode = value that occurs most frequently in a data set

Median = middle value that separates the greater and lesser halves of a data set

Mean = sum of all data points divided by number of data points

Range = value obtained by subtracting the smallest observation (sample minimum) from the greatest (sample maximum)

AP Biology - Unit 2 - Cell Structure and Function - pages 5-10

Rate and Growth

Rate

$$\frac{dY}{dt}$$

dY = amount of change

dt = change in time

Population Growth

$$\frac{dN}{dt} = B - D$$

B = birth rate

D = death rate

Exponential Growth

$$\frac{dN}{dt} = r_{max}N$$

N = population size

K = carrying capacity

r_{max} = maximum per capita growth rate of population

Logistic Growth

$$\frac{dN}{dt} = r_{max}N\left(\frac{K-N}{K}\right)$$

Simpson's Diversity Index

$$\text{Diversity Index} = 1 - \sum\left(\frac{n}{N}\right)^2$$

n = total number of organisms of a particular species

N = total number of organisms of all species

Water Potential (Ψ)

$$\Psi = \Psi_P + \Psi_S$$

Ψ_P = pressure potential

Ψ_S = solute potential

The water potential will be equal to the solute potential of a solution in an open container because the pressure potential of the solution in an open container is zero.

The Solute Potential of a Solution

$$\Psi_S = -iCRT$$

i = ionization constant (1.0 for sucrose because sucrose does not ionize in water)

C = molar concentration

R = pressure constant (R = 0.0831 liter bars/mole K)

T = temperature in Kelvin (°C + 273)

pH* = $-\log[H^+]$

Surface Area and Volume

Surface Area of a Sphere

$$SA = 4\pi r^2$$

Volume of a Sphere

$$V = \frac{4}{3}\pi r^3$$

Surface Area of a Rectangular Solid

$$SA = 2lh + 2lw + 2wh$$

Volume of a Rectangular Solid

$$V = lwh$$

Surface Area of a Cylinder

$$SA = 2\pi rh + 2\pi r^2$$

Volume of a Cylinder

$$V = \pi r^2 h$$

Surface Area of a Cube

$$SA = 6s^2$$

Volume of a Cube

$$V = s^3$$

r = radius

l = length

h = height

w = width

s = length of one side of a cube

SA = surface area

V = volume

16. The value for Ψ in root tissue was found to be -3.3 bars. If you place the root tissue in a 0.1 M solution of sucrose at 20°C in an open beaker, what is the Ψ of the solution, and in which direction would the net flow of water be? Show your work. Hint: figure the solute potential of the sucrose, add it to the pressure potential for water in an open beaker. Then compare that to the Ψ in the root tissue.

AP Biology - Unit 2 - Cell Structure and Function - pages 5-10

17. NaCl dissociates into 2 particles in water: Na+ and Cl-. If the solution in question 1 contained 0.1 M NaCl instead of 0.1 M sucrose, what is the Ψ of the solution, and in which direction would the net flow of water be? Hint: remember to check the ionization number. Then figure the Ψ_S and the Ψ for the solution, and then compare it to the Ψ for the root.

18. A red blood cell has a Ψ_S of -4.4 bars. It is placed in a solution of .3M glucose. What will happen to the cell?

2.9 - Mechanisms of Transport

19. Membranes and membrane-bound organelles in eukaryotic cells compartmentalize intracellular metabolic processes and specific enzymatic reactions. **Identify** the organelles that compartmentalize intracellular metabolic processes AND state the processes that are occurring

2.10 - Cell Compartmentalization

20. Internal membranes facilitate cellular processes.

A. Identify two organelles that contain internal membranes AND state the process that occur in each organelle.

B. Explain how the folding of the internal membrane is beneficial to carrying out the process.

C. Describe the involvement of the membrane in the cellular processes.

2.11 - Origins of Cell Compartmentalization

21. Evolutionary relationship between Eukaryotes and prokaryotes

A. **Describe** similarities and differences and compartmentalization between prokaryotic and eukaryotic cells

B. **Describe** the endosymbiotic theory

C. **Describe** two pieces of evidence that support the endosymbiotic theory

AP Biology - Unit 3 - Cellular Energetics - pages 11-12

Part 1 - Review the Basics

Use complete sentences to answer the following questions. These questions are based on prior Biology 1 knowledge.

1) Why energy? How do organisms capture, store, and regulate the use of energy in their environments? Be sure to include both Autotrophs, Heterotrophs, and Chemotrophs.

Part 2 - AP Biology Review

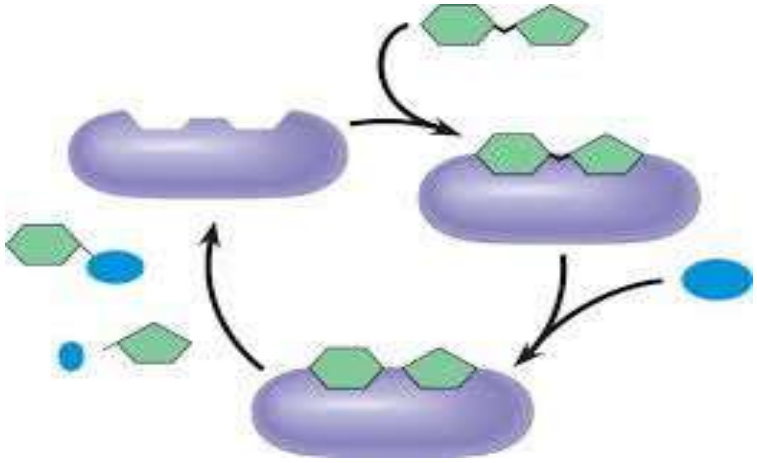
Use complete sentences to answer the following questions. You may use your textbook, old homework assignments, vocabulary review, etc. to help answer the questions.

3.1 - Enzyme Structure

1) Compare the structure of an enzyme to its substrate molecule that it interacts with.

2) Describe the properties of an enzyme. What macromolecule group do they belong to?

3) Label the diagram below.



3.2 - Enzyme Catalysis

4) Define catalyst and explain how enzymes catalyze reactions.

5) Define denaturation. Explain how changes in pH can denature enzymes. What is the equation relating pH to H^+?

3.3 - Environmental Impacts of Enzyme Function

6) Sketch graphs of the effects of temperature, concentration, and pH on enzyme activity. Indicate the optimal range on each graph. Relate the effect of temperature to enzyme structure.

7) Compare competitive and noncompetitive inhibitors. What is an allosteric interaction?

AP Biology - Unit 3 - Cellular Energetics - pages 11-12

3.4 - Cellular Energy

8) Why are exergonic and endergonic reactions coupled in biochemical pathways? Why are these pathways sequential?

9) Why is energy needed by organisms? This should be centered on the cellular level.(ie. Not to grow and live)

3.5 - Photosynthesis

10) What is the overall process of photosynthesis? Which organisms evolved this process first? What evidence supports that idea?

11) What is the role of chlorophylls in the light-dependent reactions? What are the inputs and outputs of these processes? What are Photosystems I and II and how are they related? Explain the importance of the ETC and ATP synthase. What are the inputs and products of the Calvin cycle?

3.6 - Cellular Respiration

12) How are fermentation and cellular respiration similar and different? Which organisms carry out these processes?

13) What is the role of the ETC in cellular respiration? Where does the ETC occur in eukaryotes? Prokaryotes? What are the electron carriers? What is the final electron acceptor?

14) Make a chart of the inputs and products of glycolysis, ETC, Krebs cycle. Include cellular location.

15) Diagram the ADP/ATP cycle.

3.7 - Fitness

16) In the evolutionary sense, List 3 organisms that have high fitness and explain why? List 3 organisms that have a relatively low fitness and why?

17) Organisms have several differing types of chlorophylls. Explain how this variation enables these organisms to have a greater fitness.

AP Biology - Unit 4 - Cell Communication and Cell Cycle - pages 13-15

****ALERT** College Board will present a thorough and riveting review of this topic on April 20 - watch it on the College Board YouTube Channel at https://www.youtube.com/watch?v=fsRy8cF0bLY&list=PLoGgviqq4847VchRdUdvbDPzsp9ResrjD&index=19**

Part 1 - Review the Basics

Use complete sentences to answer the following questions. These questions are based on prior Biology 1 knowledge.

1) Think back to first learning about organelles in Baby Bio. Which **organelle** do you think is the most important in Cell Communication? Defend your answer, referencing how the **structure** of this organelle supports its **function**.

2) Define **MITOSIS** using 5 words or less.

3) We generally divide mitosis into **5 phases**. List them with a brief summary of the main event of each phase.

Part 2 - AP Biology Review

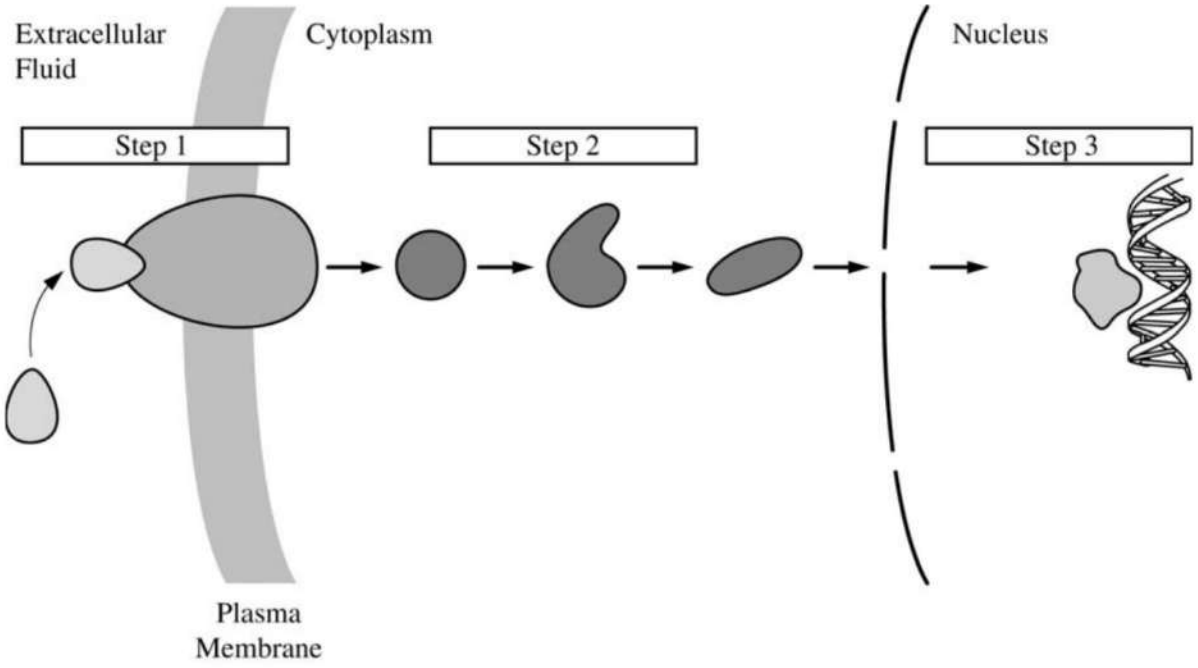
Use complete sentences to answer the following questions. You may use your textbook, old homework assignments, vocabulary review, etc. to help answer the questions.

4.1 - Cell Communication

1) Cells can communicate with other cells in different ways, depending on how close together they are (proximity). Describe and give one example of each of the four methods of cellular communication (also called cell signalling):
    - Juxtacrine
    - Autocrine
    - Paracrine
    - Endocrine

AP Biology - Unit 4 - Cell Communication and Cell Cycle - pages 13-15

4.2 - Introduction to Signal Transduction



2) This figure represents an example of <u>cell communication</u> in the form of a <u>signal transduction pathway</u>. Signal transduction pathways function as a link between signal reception and <u>cellular responses</u> - think of this as a flow chart. Put the following statements in order so that they describe what is happening in the pathway above from left to right:

A. Response occurs - in this case, protein synthesis.
B. Ligand (a chemical messenger shaped like a little guitar pick, in this case) travels towards the receptor protein.
C. Signal travels from the plasma membrane to the nucleus.
D. Binding of the ligand and the receptor protein triggers a cascade that may change the shape of the signal.
E. Ligand and receptor protein bind, triggering a signal.

4.3 - Signal Transduction

3) These pathways influence how cells respond to their environment. These responses may include changes in gene expression, cell function, phenotype, or even trigger apoptosis. Choose <u>one</u> of the examples below to research and explain in a paragraph how your choice illustrates signal transduction:

- Mating pheromones
- Ethylene levels in fruit
- HOX genes and their role in human development (& other organisms)

AP Biology - Unit 4 - Cell Communication and Cell Cycle - pages 13-15

4.4 - Changes in Signal Transduction Pathways

4) Refer back to the diagram in Section 4.2. Describe what you think could happen if a mutation occurred in this process. Include in your answer a real-world example of a human (or other animal) disorder that is caused by a breakdown in cell communication.

4.5 - Feedback - Organisms use feedback mechanisms to maintain their internal environments and respond to internal and external environmental changes.

5) Describe the difference between a positive feedback mechanism and a negative feedback mechanism.

6) Identify these four examples as either positive or negative feedback mechanisms

- Onset of labor in childbirth
- Blood sugar regulation by insulin/glucagon
- Ripening of fruit
- Lactation in mammals

4.6 - Cell Cycle

7) List 2 reasons that a cell needs to go through mitosis.

8) Briefly describe these key events of the cell cycle:

- Interphase → G1 =
  - S =
  - G2 =
- Mitosis = (Done! You did this in 5 words or less above!)
- Cytokinesis =

4.7 - Regulation of Cell Cycle

9) Describe how the cell cycle is regulated and **discuss** ONE consequence of abnormal regulation.

- Hint: It would be very helpful to do a quick sketch of the cell cycle for yourself, and noting where all the checkpoints are located - and what step does NOT proceed if the checkpoint is NOT passed.

AP Biology - Unit 5 - Heredity - pages 16 - 22

Part 1 - Review the Basics

Use complete sentences to answer the following questions. These questions are based on prior Biology 1 knowledge.

1) Compare and contrast mitosis and meiosis.

2) Compare and contrast somatic cells with gametic cells.

3) What is the relationship between DNA, chromatin, and a chromosome?

4) What does it mean if two chromosomes are said to be “homologous?”

5) When does “crossing over” occur, and what is its significance to organisms?

6) What is the relationship between surface-area-to-volume ratio and proper cell function?

7) Explain what happens during each of the following steps of the cell cycle:

- interphase
- prophase
- metaphase
- anaphase
- telophase
- cytokinesis

Part 2 - AP Biology Review

Use complete sentences to answer the following questions. You may use your textbook, old homework assignments, vocabulary review, etc. to help answer the questions.

5.1 - Meiosis

1) Describe similarities and/ or differences between the phases and outcomes of mitosis and meiosis.

2) Explain how meiosis results in the transmission of chromosomes from one generation to the next.

AP Biology - Unit 5 - Heredity - pages 16 - 22

5.2 - Meiosis and Genetic Diversity

3) Explain how each of these processes of meiosis generates genetic diversity.
    a) Separation of homologous chromosomes
    b) Crossing over
    c) Random assortment

4) Chi Square Review and Problems

The Equation:

Chi-Square

$$\chi^2 = \sum \frac{(o-e)^2}{e}$$

o = observed results

e = expected results

Σ = sum of all

Degrees of freedom are equal to the number of distinct possible outcomes minus one.

The Table:

Chi-Square Table

p value	Degrees of Freedom							
	1	2	3	4	5	6	7	8
0.05	3.84	5.99	7.81	9.49	11.07	12.59	14.07	15.51
0.01	6.63	9.21	11.34	13.28	15.09	16.81	18.48	20.09

Lets review!

1. Chi square example with punnett square
    a. Hypothesis vs. Null Hypothesis (H_0)
        i. *Hypothesis:* "here is what we think is going to be different" Chance is at play (evolution, etc.)
        ii. *Null Hypothesis:* "there is no difference" There is no relationship between measured variables
    b. Results:
        i. Bigger the number of O-E, the more likely we will say it is significantly significant.
        ii. 95% sure that our conclusion is based off of our data and not some random chance event.
        iii. Notice how small the numbers are at p = 0.99 - almost ANY difference could be considered significant (unacceptable by scientific standards)

AP Biology - Unit 5 - Heredity - pages 16 - 22

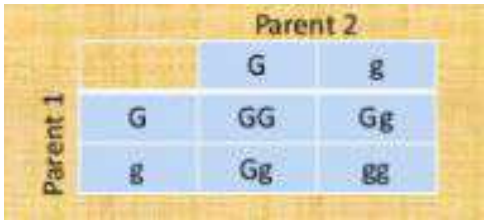
Percentage Points of the Chi-Square Distribution

Degrees of Freedom	Probability of a larger value of x^2								
	0.99	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.01
1	0.000	0.004	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.020	0.103	0.211	0.575	1.386	2.77	4.61	5.99	9.21
3	0.115	0.352	0.584	1.212	2.366	4.11	6.25	7.81	11.34
4	0.297	0.711	1.064	1.923	3.357	5.39	7.78	9.49	13.28
5	0.554	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09
6	0.872	1.635	2.204	3.455	5.348	7.84	10.64	12.59	16.81
7	1.239	2.167	2.833	4.255	6.346	9.04	12.02	14.07	18.48
8	1.647	2.733	3.490	5.071	7.344	10.22	13.36	15.51	20.09
9	2.088	3.325	4.168	5.899	8.343	11.39	14.68	16.92	21.67
10	2.558	3.940	4.865	6.737	9.342	12.55	15.99	18.31	23.21
11	3.053	4.575	5.578	7.584	10.341	13.70	17.28	19.68	24.72
12	3.571	5.226	6.304	8.438	11.340	14.85	18.55	21.03	26.22
13	4.107	5.892	7.042	9.299	12.340	15.98	19.81	22.36	27.69
14	4.660	6.571	7.790	10.165	13.339	17.12	21.06	23.68	29.14
15	5.229	7.261	8.547	11.037	14.339	18.25	22.31	25.00	30.58
16	5.812	7.962	9.312	11.912	15.338	19.37	23.54	26.30	32.00
17	6.408	8.672	10.085	12.792	16.338	20.49	24.77	27.59	33.41
18	7.015	9.390	10.865	13.675	17.338	21.60	25.99	28.87	34.80
19	7.633	10.117	11.651	14.562	18.338	22.72	27.20	30.14	36.19
20	8.260	10.851	12.443	15.452	19.337	23.83	28.41	31.41	37.57
22	9.542	12.338	14.041	17.240	21.337	26.04	30.81	33.92	40.29
24	10.856	13.848	15.659	19.037	23.337	28.24	33.20	36.42	42.98
26	12.198	15.379	17.292	20.843	25.336	30.43	35.56	38.89	45.64
28	13.565	16.928	18.939	22.657	27.336	32.62	37.92	41.34	48.28
30	14.953	18.493	20.599	24.478	29.336	34.80	40.26	43.77	50.89
40	22.164	26.509	29.051	33.660	39.335	45.62	51.80	55.76	63.69
50	27.707	34.764	37.689	42.942	49.335	56.33	63.17	67.50	76.15
60	37.485	43.188	46.459	52.294	59.335	66.98	74.40	79.08	88.38

iv. Statistical significance is the likelihood that a relationship between two or more variables is caused by something other than chance. Statistical significance is used to accept or reject the null hypothesis, which hypothesizes that there is no relationship between measured variables (observed and expected).SCIENTISTS DO NOT WANT RANDOMNESS!!!!

c. Example:

i. Biologists wish to cross pairs of tobacco plants having genetic makeup Gg, indicating that each plant has one dominant gene G and one recessive gene g for color. Each offspring plant will receive one gene for color from each parent. The Punnett Square shows the possible combinations of genes received by the offspring



ii. Hypothesis vs. Null Hypothesis

1) The Punnett Square suggests that the expected ratio of green GG to yellow-green GG to albino gg tobacco plants should be 1:2:1. The Biologists predict that 25% of the offspring will be green, 50% will be yellow-green, and 25% will be albino.
2) Hypothesis: THERE IS A DIFFERENCE. There will be a selective advantage to being albino, so the population will increase in numbers through subsequent
3) Null Hypothesis: THERE IS NO DIFFERENCE. Each generation will follow the mendelian law of genetics resulting in the expected 1:2:1 or 25%:50%:25%.

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iii. Observed results

1. To test their hypothesis about the distribution of offspring, the biologists RANDOMLY mated selected pairs of yellow-green parent plants (heterozygote). Of 84 offspring, 23 plants were green, 50 were yellow-green, and 11 were albino. Do these data differ significantly from what the biologists have predicted? Carry out an appropriate tests at the p = 0.05 level to answer.

	Possible Genotypes			**Total**
Data Chart	**GG (green) (hint: remember 25%)**	**Gg (yellow-green) (hint: remember 50%)**	**Gg (albino) (hint: remember 25%)**	
Observed (o)	23	50	11	84
Expected (e)				
Difference (o-e)				
Difference Squared $(o-e)^2$				
$(o-e)^2/e$				
$\Sigma (o-e)^2/e = \mathbf{X^2}$				

	Possible Genotypes			**Total**
Data Chart	**GG (green) (hint: remember 25%)**	**Gg (yellow-green) (hint: remember 50%)**	**Gg (albino) (hint: remember 25%)**	
Observed (o)	23	50	11	84
Expected (e)	21	42	21	84
Difference (o-e)	2	8	-10	
Difference Squared $(o-e)^2$	4	64	100	
$(o-e)^2/e$	.17	1.28	9.09	
$\Sigma (o-e)^2/e = \mathbf{X^2}$				**10.54**

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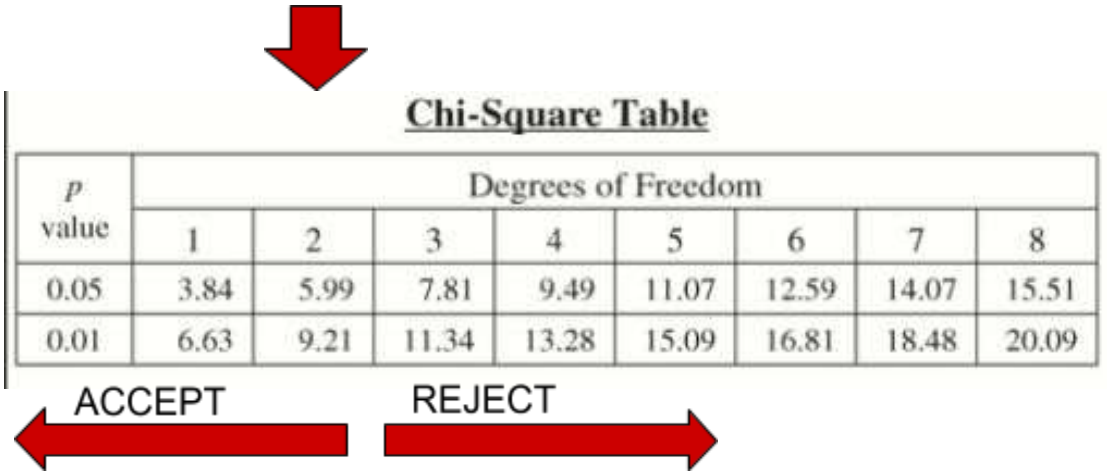
iv. **What does $X^2 = 10.54$ mean?**
   1. **How many variables are there? Therefore, how many degrees of freedom?**
   2. **What is the p value we are going to use? Therefore, what number in the chart are we looking at?**



Chi-Square Table

p value	Degrees of Freedom							
	1	2	3	4	5	6	7	8
0.05	3.84	5.99	7.81	9.49	11.07	12.59	14.07	15.51
0.01	6.63	9.21	11.34	13.28	15.09	16.81	18.48	20.09

v. CONCLUSION:
   1. Reject Null hypothesis, There is a statistical significant difference between observed and expected.
   2. CAN YOU BE 99% CONFIDENT?

5.3 - Mendelian Genetics

5) Explain how shared, conserved, fundamental processes and features support the concept of common ancestry for all organisms.

6) Explain the inheritance of genes and traits described by Mendal's laws

   a) Law of Segregation:

   b) Law of Independent Assortment:

7) Probability Practice Problems
   i) The Product Rule: For the independent events X and Y, the probability (P) of them both occurring (X and Y) is $P(X) \cdot P(Y)$

   ii) The Sum Rule: For mutually exclusive event X and Y, the probability (P) that one of them will occur (X or Y) is P(X) + P(Y)

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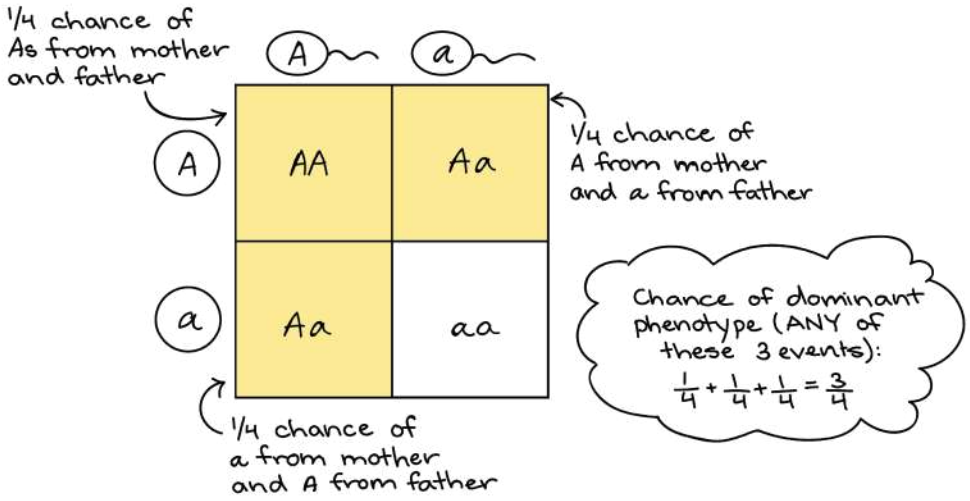

Mendelian Segregation of Individual Genes

7a) A pea plant with red flowers is mated with a pea plant with white flowers. Half of the offspring have red flowers, and half have white. If the allele for red flower color is dominant to the allele for white flower color, what were the genotypes of the parents?

7b) Suppose a pea plant has three alleles for flower-color, red, yellow, and white. Red is dominant to yellow and white, and yellow is dominant to white. If a plant with one red allele and one white allele is mated to a plant with one yellow allele and one white allele:

What percentage of the offspring will have red flowers?
What percentage of the offspring will have yellow flowers?
What percentage of the offspring will have white flowers?

7c) In humans, there is a gene locus for blood type. The three alleles are A, B, and O. A and B are codominant to each other and dominant to O. Genotypes AA and AO give blood type A. Genotypes BB and BO give blood type B. Genotype AB gives blood type AB. And genotype OO gives blood type O. A man of genotype AB marries a woman of genotype BO. If they have eight children:

On average, how many will have blood type A?
On average, how many will have blood type B?
On average, how many will have blood type AB?

7d) A woman with blood type B marries a man with blood type O. If they have a child of blood type O, what is the probability that the mother's genotype is BO? If they have a child of blood type B, can you compute the probability that the mother's genotype is BO; that the mother's genotype is BB? Why?/why not?

7e) Two carriers for the mutant CF allele marry and have a child. What is the probability that the child will have CF; that the child will be phenotypically normal; that the child will be a phenotypically normal carrier?

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5.4 - Non-Mendelian Genetics

8) Explain deviations from Mendel's model of the inheritance of traits

   a) Sex-linked traits

   b) Multiple genes

   c) Non-nuclear inheritance

5.5 - Environmental Effects on Phenotype

9) Explain how the same genotype can result in multiple phenotypes under different environmental conditions (examples: Height and weight in humans, Flower color based on soil pH)

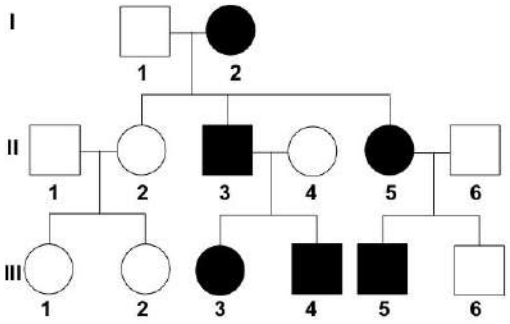
5.6 - Chromosomal Inheritance

10) Explain how chromosomal inheritance generates genetic variation in sexual reproduction.

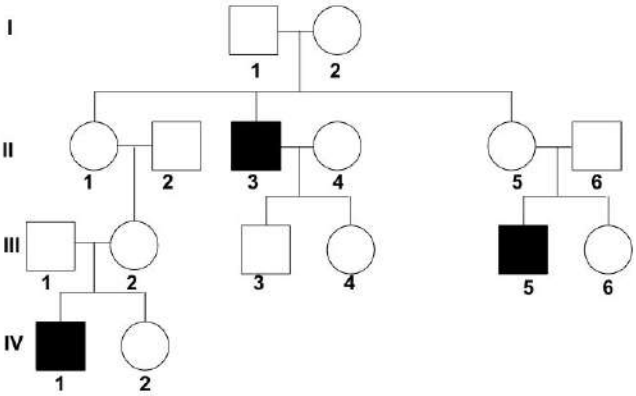
11) What occurs when single or mutated alleles, or specific chromosomal changes happen?

12) Pedigree Problems:

(a) What type of inheritance is shown here? How do you know?



(b) What type of inheritance is shown here? How do you know?



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Part 1 - Review the Basics

Use complete sentences to answer the following questions. These questions are based on prior Biology 1 knowledge.

1) What does it mean when DNA replication is referred to as a "semiconservative" process?
2) Briefly describe what occurs during the processes of *transcription* and *translation.*
3) Which enzyme is responsible for transcribing DNA into RNA?
4) What are the differences between introns and exons?

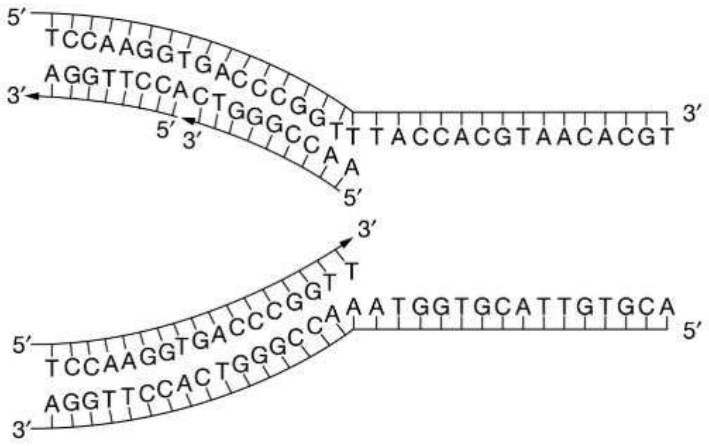
Part 2 - AP Biology Review

Use complete sentences to answer the following questions. You may use your textbook, old homework assignments, vocabulary review, etc. to help answer the questions.

6.1 - DNA and RNA Structure

1) What is the advantage of having a single circular chromosome (prokaryotes)? Are there any advantages to having multiple linear chromosomes (eukaryotes)?
2) What are plasmids? How are they used by organisms, and how are they used in biotechnology experiments?

6.2 - Replication



3) Using the above diagram as a reference, explain how DNA is replicated using the following terms: leading strand, lagging strand, 5', 3', RNA primer, Okazaki fragment, DNA polymerase, helicase, ligase

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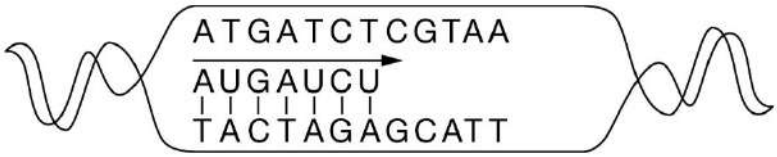
6.3 - Transcription and RNA Processing



4) Both replication and transcription start out with DNA as a template. Which process is being shown in the above diagram? Use three specific observations to justify your answer.

Step 1 Step 2 Step 3

DNA ⟶ Pre-mRNA ⟶ mRNA ⟶ Protein

5) What changes must be made to pre-mRNA (in step 2 above) before it can leave the nucleus and be translated at a ribosome?

6) Briefly explain the gene regulation method known as *alternative splicing*.

6.4 - Translation

7) What is the biological significance of there being codon combinations that code for just 20 amino acids?

8) In general, how do viruses modify a host cell's gene expression?

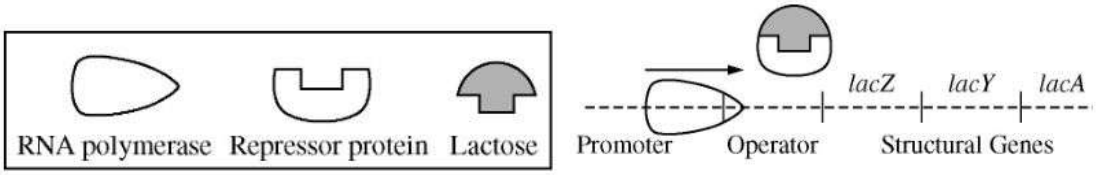
9) How do retroviruses differ from other viruses in how they incorporate their genetic material into host cells?

Second Base in Codon

First Base in Codon	U	C	A	G	Third Base in Codon
U	UUU, UUC: Phe; UUA, UUG: Leu	UCU, UCC, UCA, UCG: Ser	UAU, UAC: Tyr; UAA Stop; UAG Stop	UGU, UGC: Cys; UGA Stop; UGG Trp	U C A G
C	CUU, CUC, CUA, CUG: Leu	CCU, CCC, CCA, CCG: Pro	CAU, CAC: His; CAA, CAG: Gln	CGU, CGC, CGA, CGG: Arg	U C A G
A	AUU, AUC, AUA: Ile; AUG Met or Start	ACU, ACC, ACA, ACG: Thr	AAU, AAC: Asn; AAA, AAG: Lys	AGU, AGC: Ser; AGA, AGG: Arg	U C A G
G	GUU, GUC, GUA, GUG: Val	GCU, GCC, GCA, GCG: Ala	GAU, GAC: Asp; GAA, GAG: Glu	GGU, GGC, GGA, GGG: Gly	U C A G

6.5 - Regulation of Gene Expression

10) What are operons? Why do only prokaryotes have operons, while eukaryotes have to use other methods to regulate gene expression?



11) Gene expression can be "turned on" by the presence of an inducer. Use the *lac* operon to explain how an inducible system of genes works. The diagrams above (key on the right, and a diagram of an operon while lactose is present) may help.

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12) Explain how the epigenetic processes of methylation and histone modification can lead to changes in gene expression. (NOTE: If you are struggling to understand epigenetics, the YouTube video “Why Women Are Stripey” should be helpful!)

6.6 - Gene Expression and Cell Specialization

13) Explain how the binding of transcription factors to promoter regions affects gene expression and/or the phenotype of the organism.

14) What is the role of microRNA (mrRNA) in gene expression?

15) A cell in the heart is genetically identical to a cell in the stomach, despite the two cells having drastically different structures and functions. How can the differences in these cells be explained despite their genetic similarities?

6.7 - Mutations

16) How do mutations contribute to the process of evolution?

17) In an organism, explain how a mutation can have a positive effect, negative effect, or a neutral effect.

18) How does the process of horizontal/lateral gene transfer lead to genetic diversity?

6.8 - Biotechnology

19) How are transformation experiments used to genetically modify organisms?

20) According to the gel electrophoresis results shown below, who are the parents of Individual 2? Explain how you reached your conclusion.