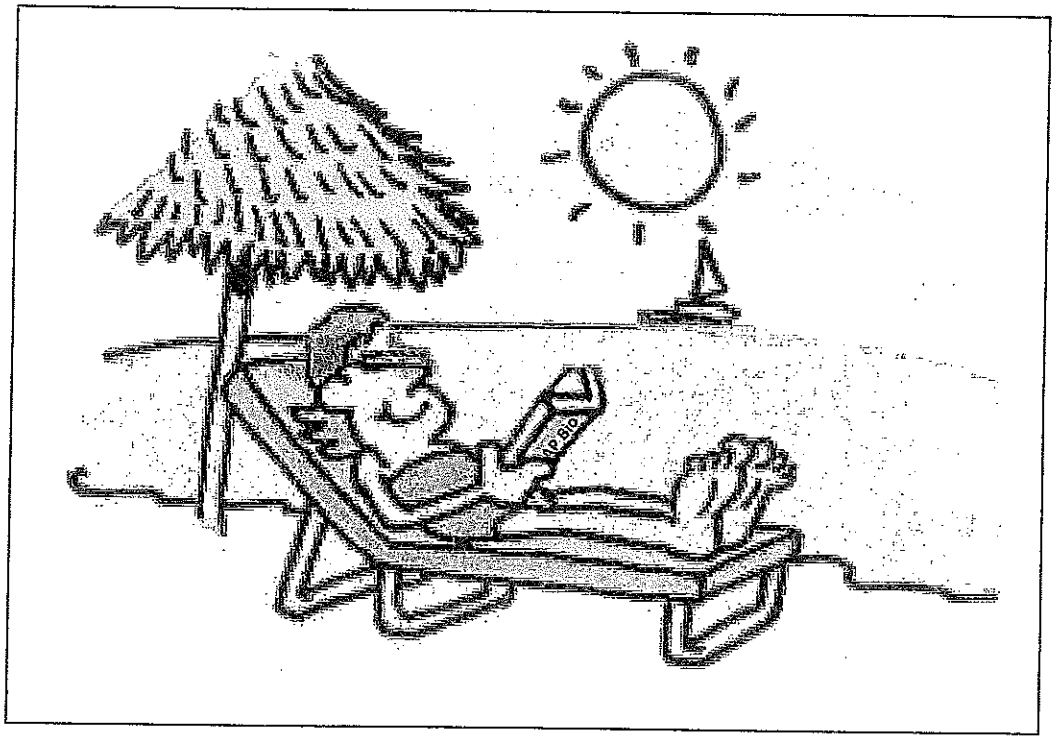
AP Biology

Summer Assignment 2016



Name: _____

Due Date: August 17, 2016 (First day of class)

AP Biology

Table of Contents for Summer Assignment

Directions

Summer Success Camp Participants: ***If you are enrolled in and are participating in the Summer Success Camp, you do NOT need to complete this packet.***

Reading Guides: You will need to pick up our textbook, Principles of Life, to complete the reading guides. Use complete, yet concise statements. Please do not reword the question.

Math Review: Show your work and use proper units. Answer questions using complete, yet concise statements.

Due Date

The completed packet is due the first day of class (8/17/16). No late work will be accepted.

Questions

Contact Mrs. Pierce at lpierce@lphs.org

Unit One

Chapter 1: Principles of Life

Chapter Outline

1.1 - Living organisms share common aspects of structure, function, and energy flow.
1.2 - Genetic systems control the flow, exchange, storage, and use of information.
1.3 - Organisms interact with and affect their environments.
1.4 - Evolution explains both the unity and diversity of life.
1.5 - Science is based on quantifiable observations and experiments.

Living organisms share many common aspects as a result of having evolved from a common ancestor. This chapter provides you with an overview of life, genetics, and evolution that will help you to understand life and how scientists look at the world. In the laboratory portion of this course, you will be doing many activities and laboratories using inquiry that will help you to think like a scientist. The science practices at the end of each chapter will assist you to establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena.

Chapter One ties principally with **Big Idea 1: The process of evolution drives the diversity and unity of life** in the AP Biology Curriculum Framework. Below are the essential knowledge areas found in Chapter One:

1.a.1 Natural selection is a major mechanism of evolution.
1.b.1 Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.
1.b.2 Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested.
1.d.1 There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence.
1.d.2 Scientific evidence from many different disciplines supports models of the origin of life.

Chapter Review

Section 1.1 is an overview of living organisms and how they are connected by their shared traits.

1. Organisms share many conserved processes that are widely distributed among organisms today. Briefly outline the distinctive characteristics of life shared by all living organisms.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

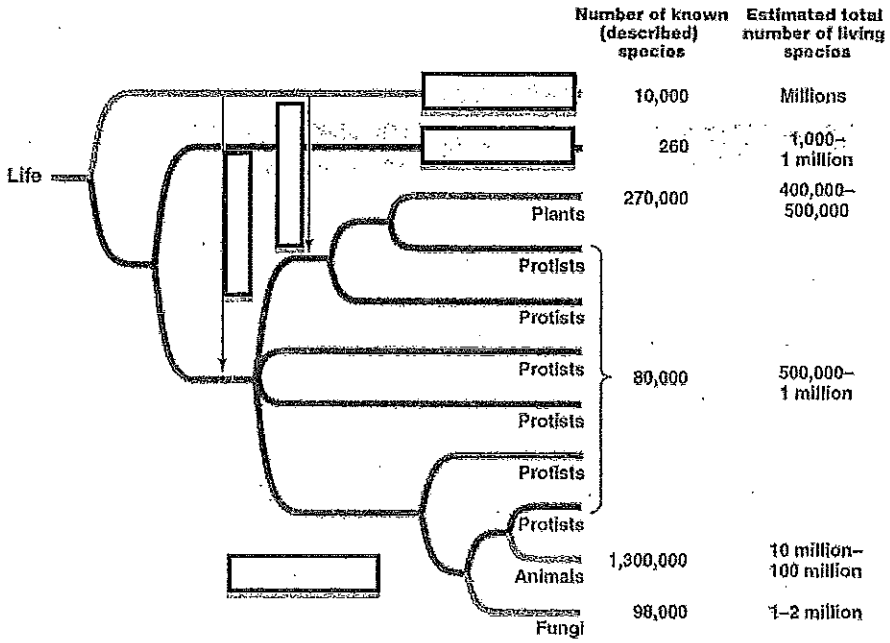
h. _____

2. How do the above shared characteristics (among widely distributed organisms) provide evidence for evolution?

3. There are several hypotheses about the evolution of early life on Earth. Once the first cells evolved, they needed energy and raw materials for metabolism. Briefly explain how the first cells found on the earth obtained these nutrients and raw materials.

4. Briefly describe and discuss how living organisms have altered the oxygen content of the atmosphere over the past three billion years.

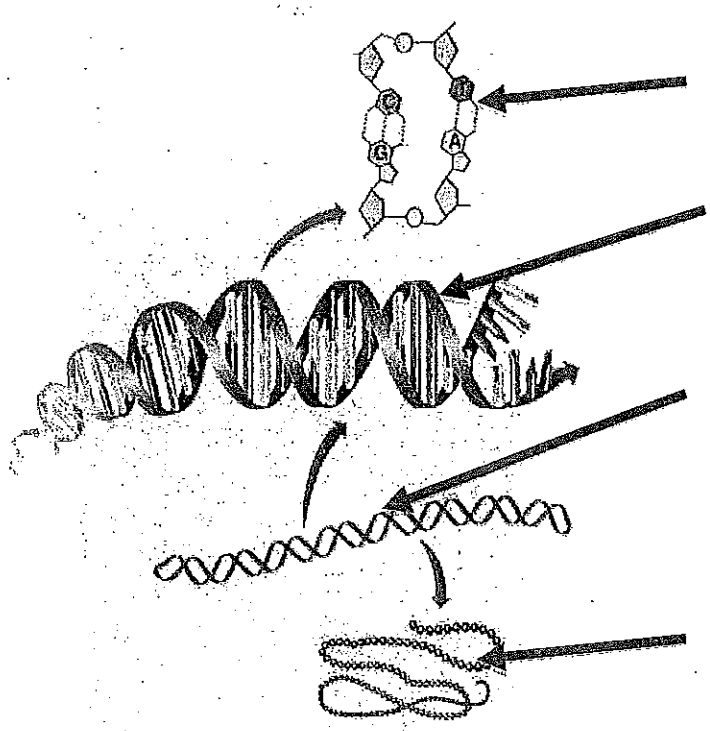
5. Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested. In the figure below, label the two vertical boxes as "mitochondria" or "chloroplasts" at the arrows representing "endosymbiotic events." In each of the 3 horizontal boxes, write the name of the domain for that group of organisms.



PRINCIPLES OF LIFE, Figure 1.4

Section 1.2 outlines some basic genetics to help you know how information is transmitted from one generation to the next.

6. In the figure to the right, label: DNA, nucleotide, gene, protein.



PRINCIPLES OF LIFE, Figure 1.5

7. Each of the cells in an individual mouse contain the same genes, but the mouse has many different types of cells: for example, muscle cells, nerve cells, skin cells, and many more. Describe how cells that have identical DNA and genes can become different types of cells.

Section 1.3 explains how all living organisms interact with the environment and with other organisms.

8. Define homeostasis:

9. Regulation is a key component of all living organisms in maintaining homeostasis. Explain how the opening and closing of stomata in plants (a feedback loop) resembles a heating and cooling system that keeps the temperature of your room comfortable.

10. The interactions of organisms with others is a topic of primary interest in the field of ecology. List 3 specific examples of how organisms interact with one another, and describe the interaction as competition, predation or cooperation.

a.

b.

c.

Section 1.4 discusses how evolution is the central unifying theme of biology and provides a framework for organizing how we think about living systems.

11. The term "theory" is an important vocabulary word in science and is often used differently in common usage and in the scientific community. How do scientists define a theory?

12. Explain how evolution is both fact and theory.

Section 1.5 focuses on how science is based on experimentation involving data collection and observation. Scientists are guided in their work by the principles of experimental design as they work to uncover the aspects of our natural world.

13. Biologist Tyrone Hayes and his co-workers investigated the effects of the herbicide atrazine on sexual development in frogs. In their experiments, they exposed each group of tadpoles to a specific amount of atrazine, and they repeated each experiment multiple times for each treatment. Their observations suggested that frogs exposed to atrazine early in life developed multiple, mixed gonads or became de-masculinized as a result.

Below is an excerpt from the design of his experiment from the original paper found at http://www.pnas.org/content/99/8/5476.full.pdf+html

> In experiment 1, we exposed larvae to atrazine at nominal concentrations of 0.01, 0.1, 1.0, 10.0, and 25 parts per billion (ppb). Concentrations were confirmed by two independent laboratories (PTRL West, Richmond, CA, and the Iowa Hygienic Laboratory, Univ. of Iowa, Iowa City, IO). All stock solutions were made in ethanol (10 ml), mixed in 15-gallon containers, and dispensed into treatment tanks. Controls were treated with ethanol such that all tanks contained 0.004% ethanol. Water was changed and treatments were renewed once every 72 h. Each treatment was replicated 3 times with 30 animals per replicate (total of 90 animals per treatment) in both experiments. All treatments were systematically rotated around the shelf every 3 days to ensure that no one treatment or no one tank experienced position effects. Experiments were carried out at 22°C with animals under a 12-h-12-h light-dark cycle (lights on at 6 a.m.).

Every experiment has several well-defined elements. Identify the elements below found in the atrazine experiment.

a. Independent Variable: _____

b. Range of the Independent Variable: _____

c. Dependent Variable: _____

d. Control: _____

e. Constants: _____

f. Repeated Trials: _____

Science Practices & Inquiry

A key component of any biology class is the laboratory experience. Science students must be able to design and plan experiments using inquiry. In the AP Biology Curriculum Framework, there is a set of 7 Science Practices. In this chapter, we will focus on **Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question.**

Specifically, question #14 asks you to *justify the selection of the kind of data* needed to answer a particular scientific question, *design a plan* for collecting data to answer a particular scientific question, *collect data* to answer a particular scientific question, and to *evaluate sources of data* to answer a particular scientific question. (LO's 4.1, 4.2, 4.3, and 4.4)

14. After looking at the many types of fish food available at a local store, a friend asked you if flake fish food or shrimp pellets would make his goldfish grow faster. Design a controlled experiment to test this question.

> **Hint:** You are not simply writing a procedure. You should discuss all of the elements above in question #10 in paragraph form in sentences. Begin by identifying your independent and dependent variables and writing a hypothesis. This experiment will utilize many goldfish in separate containers.

Chapter 2: Life Chemistry and Energy

Chapter Outline

2.1 - Atomic Structure Is the Basis for Life's Chemistry
2.2 - Atoms Interact and Form Molecules
2.3 - Carbohydrates Consist of Sugar Molecules
2.4 - Lipids Are Hydrophobic Molecules
2.5 - Biochemical Changes Involve Energy

Living organisms such as birds and fish are made up of cells, and these cells are collections of molecules that work together. Interacting atoms make up the molecules, and it is necessary for you to understand a few details about atoms and molecules if you are going to be able to understand life. All life exists at the expense of its surrounding environment and is dependent on biochemical transformations of matter. These transformations occur within the laws of thermodynamics, specifying that energy is neither created nor destroyed and that disorder (entropy) increases during transformations.

Chapter 2 continues consideration of **Big Idea 1**, evolution, and Chapter 2 also begins your exploration of **Big Idea 2**, wherein you examine energy use by cells as you begin to catalogue the molecular building blocks of life processes. The following list includes these specific parts (essential knowledge) of the AP-Biology curriculum that are covered in Chapter 2.

1.d.2: Scientific evidence from many different disciplines supports models of the origin of life.
2.a.1: All living systems require constant input of free energy.
2.a.3: Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.
4.a.1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.
4.b.1: Interactions between molecules affect their structure and function.
4.c.1: Variation in molecular units provides cells with a wider range of functions.

Chapter Review

Concept 2.1 reviews some details about atomic structure in order to understand how molecules function in living organisms.

1. For each of the following, provide the number of electrons, protons, neutrons and atomic number in its elemental form.

	electrons	protons	neutrons	atomic number
a. hydrogen	_____	_____	_____	_____
b. carbon	_____	_____	_____	_____
c. oxygen	_____	_____	_____	_____
d. phosphorus	_____	_____	_____	_____

Concept 2.2 explains how molecules result from interactions between atoms.

2. Place each of these types of atomic interactions on the list below, based on the strength of the atomic interaction: van der Waals forces, covalent bonds, hydrogen bonds, ionic bonds.

strongest → weakest

_____ > _____ > _____ > _____

3. Define "cation" and "anion."

cation: _____

_____

anion: _____

_____

4. Use the example of sodium chloride to explain how the electrons of these two atoms are redistributed when these two atoms interact with each other.

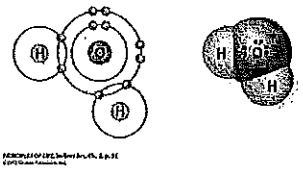
_____

_____

_____

_____

5. Name the molecule shown by the two models:



_____

Explain how the electrons of these atoms are affected by their atomic interaction, and describe what this does to the distribution of charge around the molecule.

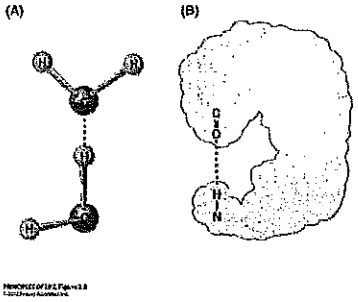
_____

_____

_____

_____

6. Drawings (A) and (B) are shown at different magnifications, and represent three molecules, two of which are interacting with each other, and the other which is interacting with itself. Explain the interactions in (A) and then in (B) and then explain why you think (A) and (B) represent the same or different numbers of atoms.



(A) _____

_____

_____

(B) _____

_____

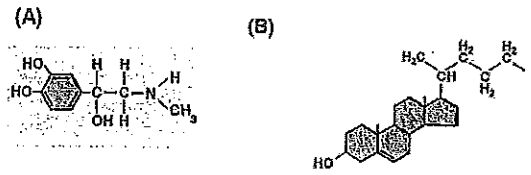
_____

More atoms are represented in drawing_____because_____

_____

_____

7. These two chemicals found in the body differ in their solubility in water: one is quite soluble in water, and the other is much less soluble. Explain using the prompts below.



Choice_____is more water-soluble because_____

_____

_____

Choice_____is less water-soluble because_____

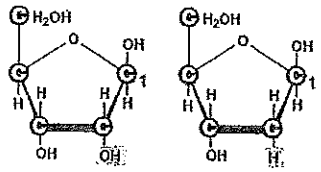
_____

_____

Concept 2.3 explains how carbohydrates, or sugar molecules, yield chemical energy when taken apart. Many organisms, including plants, catabolize (take apart) glucose and other sugars to liberate energy for their own use. Plants, of course, also synthesize sugars, by using solar energy and environmental sources of carbon dioxide and water.

8. Fill in the blanks: Solar energy drives _____ in green plants, resulting in the synthesis of _____, a monosaccharide. Sucrose is a disaccharide resulting from the formation of a _____ linkage between two monosaccharides. The starch molecule, also known as _____, is an even larger polymer of these products of these synthetic processes, and the most abundant member of this group on earth is _____.

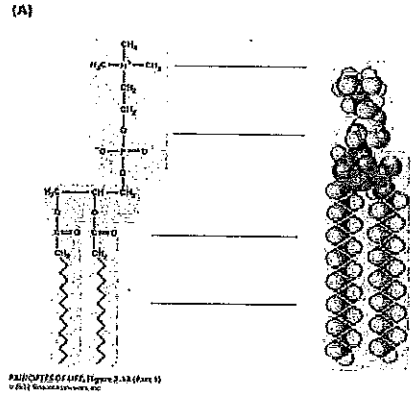
9. Number the un-numbered carbons and provide the names of each of these two monosaccharides.



_____ _____

Concept 2.4 discusses lipids (fats), which are energy-rich storage molecules.

10. Provide labels for the 4 different areas of the molecule, indicated by the 4 different shades on both representations (two models are shown).



The hydrophobic tail includes

_____.

The hydrophilic head includes

_____.

11. Steroids and other fatty substances pass readily through most cellular membranes because

_____

_____

_____

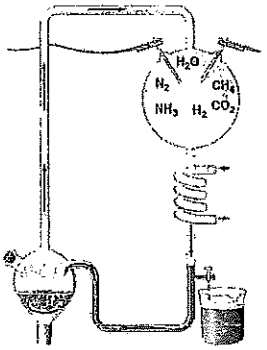
Concept 2.5 explains how energy for life comes from biochemical changes in molecules.

12. The "anabolic steroids" are drugs that are sometimes misused by people who want to increase their athletic prowess. Describe what is meant by "anabolic" as a label in this term.

Science Practices & Inquiry

In the AP Biology Curriculum Framework, there is a set of 7 Science Practices. In this chapter, we will focus on **Science Practice 6: The student can work with scientific explanations and theories.** More specifically, practice 6.2: The student can construct explanations of phenomena based on evidence produced through scientific practices.

Questions 13 – 16 ask you to construct explanations based on evidence of how variation in molecular units provides cells with a wider range of functions. (LO 4.22)



In 1953, Stanley Miller and Harold Urey set up an apparatus, depicted here, to simulate the Earth's early atmosphere. The gases they added in their original set-up were methane (CH_4), ammonia (NH_3), hydrogen (H_2), water (H_2O), carbon dioxide (CO_2), and nitrogen gas (N_2). Energy was added by passing a spark across two electrodes and by boiling the reactants. After one week of continuous sparking and boiling of this "primordial soup," several amino acids, including aspartic acid, glycine, and alanine, were found in the condensed fluid from the apparatus.

The final lines from the original paper state:

"In this apparatus an attempt was made to duplicate a primitive atmosphere of the earth, and not to obtain the optimum conditions for the formation of amino acids. Although in this case the total yield was small for the energy expended, it is possible that, with more efficient apparatus … this type of process would be a way of commercially producing amino acids.

A more complete analysis of the amino acids and other products of the discharge is now being performed and will be reported in detail shortly."

13. Define abiogenesis:

14. Define biogenesis:

15. Explain whether or not abiogenesis and biogenesis were demonstrated in the Miller-Urey experiment.

16. Discuss this claim:

"The Miller-Urey apparatus proves that life originated in a primordial sea."

Chapter 4: Cells – The Working Units of Life

Chapter Outline

4.1 - Cells provide compartments for biochemical reactions.
4.2 - Prokaryotic cells do not have a nucleus.
4.3 - Eukaryotic cells have a nucleus and other membrane-bound organelles.
4.4 - The cytoskeleton provides strength and movement.
4.5 - Extracellular structures allow cells to communicate with the external environment.

You already know that living organisms are made up of cells. Think of cells as small water-filled balloons holding a mixture of molecules and ions that work together. In this chapter you learn about intracellular organelles that compartmentalize and maximize biochemical activities necessary for cellular life. Not all cells have these organelles. In fact, the most numerous cells on the planet, those of the *Archaea* and *Bacteria*, lack organelles, and this absence of organelles is a defining characteristic of simple, ancient cells called prokaryotic cells. Eukaryotic cells, such as those in our bodies, are larger in size and have numerous membranous internal structures—these are the organelles. By concentrating certain types of processes to certain types of organelles, eukaryotic cells are extremely efficient, making larger cellular size sustainable.

The content of Chapter Four spans all four of the **Big Ideas** found in the AP Biology Curriculum Framework. The Big Ideas are a means for organizing the vast amount of information in biology. Try to develop your understanding across these **Big Ideas** and their corresponding **Enduring Understandings**.

Big Idea 1 recognizes that evolution ties together all parts of biology. In Chapter 4 we look at a theory for the development of cell complexity, thus noting:

1.d.2: Scientific evidence from many different disciplines supports models of the origin of life.

Big Idea 2 states that the utilization of free energy and use of molecular building blocks are characteristic fundamental of life processes. Specifically, Chapter 4 includes:

2.a.3: Organisms must exchange matter with the environment to grow, reproduce and maintain organization.

2.b.3: Eukaryotic cells maintain internal membranes that partition the cell into specialized regions, including the rough endoplasmic reticulum, mitochondria, chloroplasts, Golgi apparatus, nucleus, and smooth endoplasmic reticulum.

Big Idea 3 states that living systems store, retrieve and transmit information essential to life processes. Specifically, Chapter 4 lays this groundwork:

3.d.2: Cells communicate with each other through direct contact with other cells or interact from a distance via chemical signaling; examples include immune cells and plasmodesmata between plant cells.

Big Idea 4 states that biological systems interact in complex ways. Included in Chapter 4:

4.a.2: The structure and function of sub-cellular components, and their interactions, provide essential cellular processes.

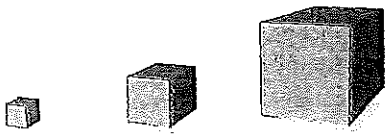
Chapter Review

Concept 4.1 introduces the idea that multicellular life forms like humans contain billions of cells. These cells come from pre-existing cells, and they are the basic unit of most life forms in biology. What we learn from studying the activities of single cells applies to whole organisms. Just like whole organisms,

cells can stay alive and persist only when nutrients are available and waste materials do not reach dangerous or toxic levels.

1. Most cells are quite small. Limits on cell size are related to limits on the rate of movement of "good stuff in" and "bad stuff out" across cell membranes. Movement rates are greatly influenced by the surface-area-to-volume ratio of the cells.

Imagine three cube-shaped cells, similar to what you saw in FIGURE 4.2 in the text. Given the dimensions shown for each cube-shaped cell here, calculate that cell's surface area, its volume and its surface-area-to-volume ratio.

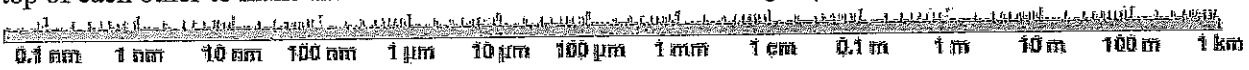


	10 μm	20 μm	100 μm
Surface area			
Volume			
SA:V ratio			

EXTRA: Now you are ready to solve the problem of circular cells on p. 59 of the text.

2. As the amount of a toxin increases around the outside of the three cube-shaped cells in the above diagram, which size of "cell" would be the first to have an enriched concentration of the toxin in its center (core) region? Explain your answer using the surface-area-to-volume ratio.

3. Use the provided logarithmic scale to determine how many 100 μm cells would you have to stack on top of each other to make the stack as tall as an athlete of 2 m height (hint: 2m = ? μm)?



PRINCIPLES OF LIFE, Figure 4.1

EXTRA: How many 10 μm prokaryotic cells would be needed for the same objective?

Concept 4.2 shows how the nucleoid region in a prokaryotic cell serves the same hereditary functions served by the nucleus in a eukaryotic cell.

4. Explain how prokaryotes carry out enzymatically-catalyzed biochemical conversions without the use of cellular organelles.

5. Describe, in general terms, the structural components of ribosomes, including a brief explanation of their function. Explain whether ribosomes are present only in eukaryotes, only in prokaryotes, or in both eukaryotes and prokaryotes.

6. Humans, perhaps unjustly, claim credit for inventing "the wheel." Discuss the argument that prokaryotes with flagella long preceded the human "invention" of the wheel.

7. Some models of the cell show it as a plastic bag full of alphabet soup with a golf ball thrown to represent the nucleus. Discuss how this model is not a good representation of a cell, and be sure you discuss the cytoskeleton in your answer.

Concept 4.3 describes how the nucleus in a eukaryotic cell serves the same hereditary functions served by the nucleoid region in a prokaryotic cell, and Eukarya have many other organelles.

8. Many hormonal signals, for example, insulin, are proteins secreted by cells. Describe the structure and function of as many cellular organelles as you can in regard to the synthesis and secretion of protein signals.

9. Identify the two primary groups of molecules that interact to become ribosomes, and include a description of where ribosomes are synthesized in eukaryotic cells.

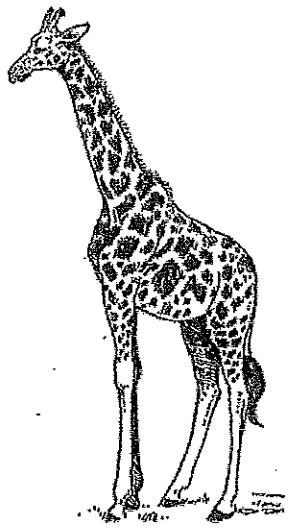
10. It's your turn to be the teacher. One of your fellow classmates tells you that: "The mitochondrion is the site where ingested glucose molecules are made into into ATP molecules." Kindly point out the error of your classmate's statement by offering a statement that is more correct. Hint: is glucose biochemically converted to ATP?

Concept 4.4 explains how the cytoskeleton of eukaryotic cells provides strength and coordinates movement.

11. Describe how the movement of a paramecium using cilia is similar to and different from that of an amoeba.

12. Compare eukaryotic flagella and cilia in terms of structural size and in number present on a flagellar (Euglena) and a ciliated (Paramecium) cell.

13. The longest cells of eukaryotes, as you might guess, are found as neurons in giraffes. Such cells can be 2 or more meters in length. The length of such cells results in an impressive mechanism for moving proteins from one end of the cell to the other. Describe the intracellular transport system, including vesicles, microtubules, and motor-proteins, for such long and thin cells.

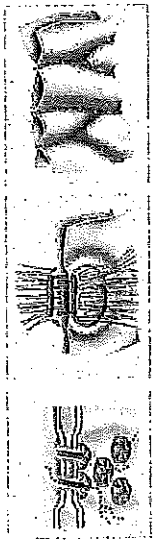


Concept 4.5 discusses how cells can interact with other cells and send and receive chemical signals at specialized regions on the surface of the cell.

14. Correct and expand upon this statement: "Adjacent plant cells are joined together by walls made up of only phospholipid molecules and proteins."

15. Correct and expand on this statement: "Sugar molecules hold adjacent animal cells together."

16. Specialized connections between adjacent cells in your heart hold them together closely so that blood does not leak out between the cells as the heart pumps. The pressure of pumping would blow apart adjacent cells were they not held tightly together by a second specialized connection. Furthermore, coordinated pumping activity of these cells relies on a third specialization between these cells. Describe how these three types of intercellular connections work together for the functioning of the heart.



17. What do the characteristics of modern cells tell us about how the first cells originated? Using your knowledge of cellular organelles, create a model (flow chart) showing the steps involved with eukaryotic cells evolving from a chemical rich environment.

Science Practices & Inquiry

In the AP Biology Curriculum Framework, there is a set of 7 Science Practices. In this chapter, we will focus on **Science Practice 2: The student can use mathematics appropriately.** More specifically, practice 2.2: The student can *apply mathematical routines* to quantities that describe natural phenomena.

Question #18 ties with Science Practice 2 relating your knowledge of math and biology together. This question asks you to use calculated surface area-to-volume ratios to predict which cell(s) might eliminate wastes or procure nutrients faster by diffusion (LO 2.6). The ability to use math and relate it to your knowledge of biology is important. Why are cells the size they are?

18. Calculate the SA:V ratio for a cube whose dimensions are typical of an eukaryotic cell, one that is 0.1 mm on a side. Explain why bacteria need to divide well before they get this large.

AP BIOLOGY: EQUATION AND FORMULA REVIEW #1

Part A: Standard Deviation

Formulas:

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

Standard Deviation = $\sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n-1}}$ where $\bar{x}$ = mean and n = size of the sample

Sample problem:

One of the lab groups collected the following data for the heights (in cm) of their Wisconsin Fast Plants:
5.4 7.2 4.9 9.3 7.2 8.1 8.5 5.4 7.8 10.2

Find the mode, median, mean, and range. Show your work where necessary.

1. Mode:
2. Median:
3. Mean:
4. Range:

Find the standard deviation by filling in the following table.

Heights (x)	Mean ($\bar{x}$)	$x - \bar{x}$	$(x - \bar{x})^2$
5.4			
7.2			
4.9			
9.3			
7.2			
8.1			
8.5			
5.4			
7.8			
10.2			

← $\Sigma(x - \bar{x})^2$

Standard deviation: $\sqrt{\frac{27.64}{9}}$ =

5. Interpret the standard deviation in the context of the problem.

P B: pH

pH = -log (H^+)

Directions: For questions 1 and 2, circle the correct answer.

1. Which is more acidic? (H^+) of 1.0×10^{-8} or 1.0×10^{-12}?

2. Which is more basic? (H^+) of 1.0×10^{-6} or 1.0×10^{-3}?

Directions: Briefly answer questions 3 & 4.

3. Stomach acid has a pH of about 1-2. What is the range of the H^+ concentration?

4. Complete the following table:

$[H_3O^+]$ or $[H^+]$	scientific notation	pH
0.1		
0.01		
0.001		
0.0001		
0.00001		
0.000001		
0.0000001		
0.00000001		
0.0000000001		
0.00000000001		

Directions: For questions 5 & 6, circle the correct answers.

5. As **[H^+]** gets smaller, scientific notation exponents get (**MORE OF LESS**) NEGATIVE, and the pH goes (**UP OR DOWN**).

6. As **[H^+]** gets larger, scientific notation exponents get (**MORE OF LESS**) NEGATIVE, and pH goes (**UP OR DOWN**).

Part C: Surface Area to Volume

Cells throughout the world have variable shapes and sizes. Because of this, and because structure is designed around function, certain shapes are optimal for certain processes.

Analyze the following cells and determine the following…

- Cell 1 (spherical) where the radius is 3 mm
- Cell 2 (flat and rectangular) where the height is 0.5 mm, length is 4 mm, width is 2 mm

1. Fill in the following table to indicate the surface area to volume ratio for both cells?

How to calculate Surface Area?	Surface area	How to calculate Volume?	Volume	Surface area to Volume Ratio
Cell 1 =				
Cell 2 =				

2. Compare the ratios and explain why one cell would be more efficient than another.

3. Are you made of many large cells or many small cells? Why? How do you grow in height?

4. Considering what you know concerning the relationship between surface area to volume of cells and efficiency in cell function, would a mammal the size of King Kong be biologically possible? Explain.