AP BIOLOGY 2017-2018

Welcome to Advanced Placement Biology. The following contains statements of the four Big Ideas that College Board has developed.

1. **The process of evolution explains the diversity and unity of life.**

2. **Biological systems utilize free energy and molecular building blocks to grow, reproduce, and to maintain dynamic homeostasis.**

3. **Living systems store, retrieve, transmit, and respond to information essential to life processes.**

4. **Biological systems interact, and these systems and their interactions possess complex properties.**

As you can see these are truly "big ideas" and in AP Biology we have a very challenging year ahead. As AP Biology students, you need to be self-directed, organized and enthusiastic. It is the student, NOT the teacher that will determine your success in this course. We will be covering a huge amount of material, after all this is an introductory college-level biology course. But with all the hard work comes a deeper understanding of Biology as well as greater appreciation of all the science subjects that you have previously taken. With this in mind, you can start your Biology education during the summer by completing the following items:

1. Complete the "CHEMISTRY REVIEW FOR AP BIOLOGY" packet which starts on page 3 of this document. Understand this <u>WILL NOT</u> be collected, checked or graded. You are responsible for the content. This assignment reviews the concepts learned in Regents Chemistry. A quiz on this material will be given during the first week of school.

2. The optional reading list below is as it says… optional. We hope that you will make the effort to read one of these exceptional books on the topic of Biology. Optional readings include:

<u>Survival of the Sickest</u> by Sharon Moalem
An evolutionary biology makes surprising connections between disease and longevity.

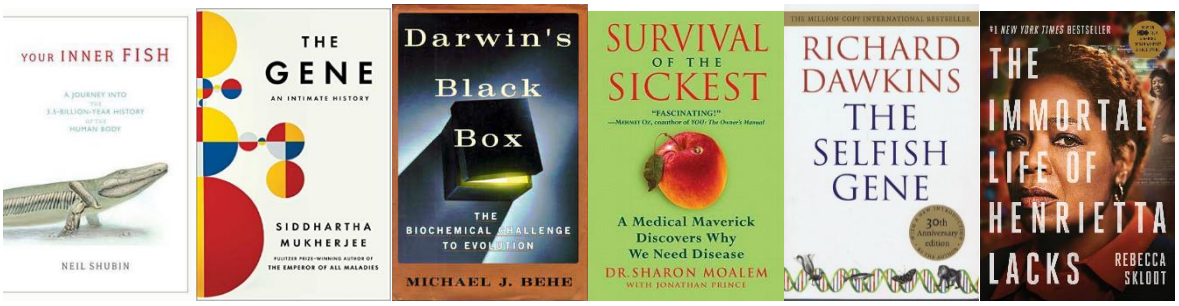
<u>Your Inner Fish</u> by Neil Shubin
A revelation of how our bodies are the legacy of ancient fish.

<u>The Selfish Gene</u> by Richard Dawkins
How your DNA is potentially immortal.

<u>Darwin's Black Box: The Biochemical Challenge to Evolution</u> by Michael Behe.
A study that nature exhibits evidence of design.

<u>The Gene: An Intimate History</u> by Siddhartha Mukherjee
The story of genetic discovery

<u>The Immortal Life of Henrietta Lacks</u> by Rebecca Skloot
An African-American woman becomes an unwitting pioneer for medical breakthroughs.



3. Obtain the following list of materials for the first day of class.

- **Composition book with graph paper (quad ruled)**
- **3 ring binder with paper**
- **4 color pen**

CHEMISTRY REVIEW FOR AP BIOLOGY

Complete the following and be knowledgeable of the concepts on the first day of school.

A. KINETICS = involves factors that affect the rate of a chemical reaction.

1. Explain why the following situations are true with regard to the Collision Theory.

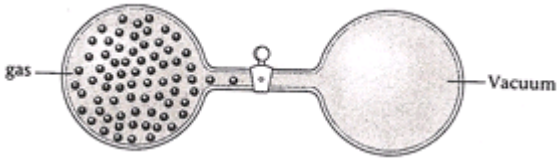
- **Sugar dissolves in hot tea more rapidly than in iced tea.**
- **Wood burns better in pure oxygen than in air.**

- **Refrigeration delays the spoilage of food?**

B. THERMODYNAMICS = concerned with heat and temperature and their relation to energy and work; the study of the driving forces of nature.

For example, a log burning in a fireplace produces ashes and heat energy. We would never see the reverse where ashes absorb heat from air to reconstruct the log.

Consider another example. A gas is trapped in one end of a vessel as shown below.



When the valve is opened, what always happens? The gas spreads evenly throughout the entire container. We would never see the particles all move to the other side.

Scientists have discovered two important driving forces that make reactions happen:

1. **enthalpy (H) = the potential energy within the chemical bonds.**
2. **entropy (S) = the disorder of the particles.**

In both cases, the driving forces in nature involve the spread of both enthalpy and entropy. Enthalpy (energy) spread disperses energy and occurs during exothermic reactions. Entropy (matter) spread occurs when there is an increase in disorder. Both forces bring stability to a system.

1. Energy spread occurs when concentrated energy disperses widely.

A. Would energy spread be occurring in endothermic or exothermic reactions? Explain.

B. Draw a potential energy diagram with the axis to illustrate this type of reaction.

C. In this situation would the value of ΔH be negative or positive?

$$\Delta H = H_{final} - H_{initial}$$

D. In this situation, which has more enthalpy, the reactants or products? Which has less enthalpy?

E. In this situation, which has more stability, the reactants or products? Which has less stability?

F. Explain, in terms of stability, why when two atoms, let's say 2 fluorine atoms combine to form a chemical bond, energy is released.

2. Matter spread means molecules of a substance spread out and occupy larger volume.

A. Would matter spread be occurring in reactions of increasing or decreasing entropy? Explain.

B. In this situation would the value of ΔS be positive or negative?

$$\Delta S = S_{final} - S_{initial}$$

C. In this situation, which has more entropy, the reactants or products? Which has less entropy?

D. In this situation, which has more stability, the reactants or products? Which has less stability?

FINAL STATEMENT

In nature, reactions move toward less enthalpy (exothermic) with the sign of ΔH being negative and more entropy (disorder) with the sign of ΔS being positive.
With regard to this final statement, and in terms of enthalpy and entropy, explain why a burning log could never occur in reverse.

The combined effect of the changes in enthalpy and entropy is called Free Energy Change or Gibbs Free Energy. When ΔG is negative, the rules of nature are followed (less enthalpy but more entropy) and the reaction occurs. Check line 1 of the chart below.

$$\Delta G = \Delta H - T\Delta S$$

Complete the chart for the different situations by plugging the sign for ΔH and ΔS and stating the sign of ΔG.

SITUATION ΔH	SITUATION ΔS	SIGN OF ΔG	REACTION OCCURS? YES OR NO
• (neg)	• (pos)	-	yes
• (pos)	• (neg)		
• (neg)	• (neg)		
• (pos)	• (pos)		

C. <u>BONDING</u> = the relationship between atoms to obtain a complete valence shell. Bonds include covalent (sharing electrons), ionic (transfer electrons) and metallic (mobile electrons). This is not to be confused with IMFAs (intermolecular forces of attraction) which include hydrogen bonding (extreme dipole), molecule-ion, and van der waals.

1. Why does solid magnesium, Mg(s), conduct electricity but solid magnesium oxide, MgO(s) does not?

2. Put the following substances in order of increasing melting point. Justify your reasoning by stating the type of bonding or IMFA in each.

$H_2O_{(s)}$ $NaCl_{(s)}$ $Cu_{(s)}$ $F_{2(g)}$

_____ _____ _____ _____

(lowest m.p.) (highest)

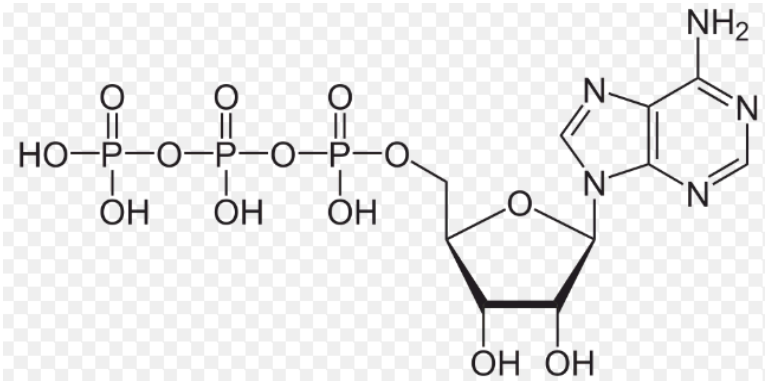
3. Draw the Lewis dot formula of any substance with ionic bonding and another with covalent bonding. Label each to show which is ionic and which is covalent.

4. Explain the trend in boiling point in terms of intermolecular attractions.

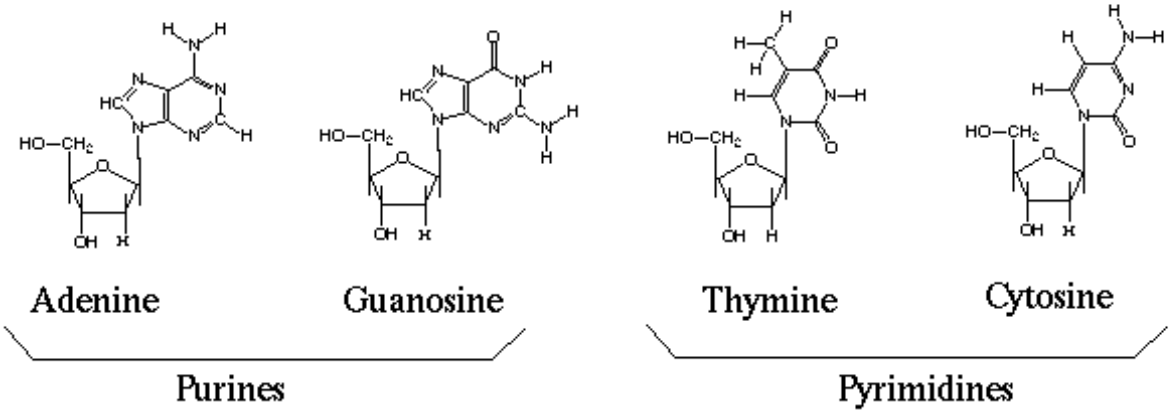
GAS	RADIUS (A)	BOILING POINT (^oC)
He	0.93	-268.9
Ne	1.12	-245.9
Ar	1.54	-185.7
Kr	1.69	-152.9
Xe	1.90	-107.1

D. ORGANIC CHEMISTRY

1. Circle, and label to identify all the functional groups in the diagram below of an ATP molecule.



The Nucleotides of DNA

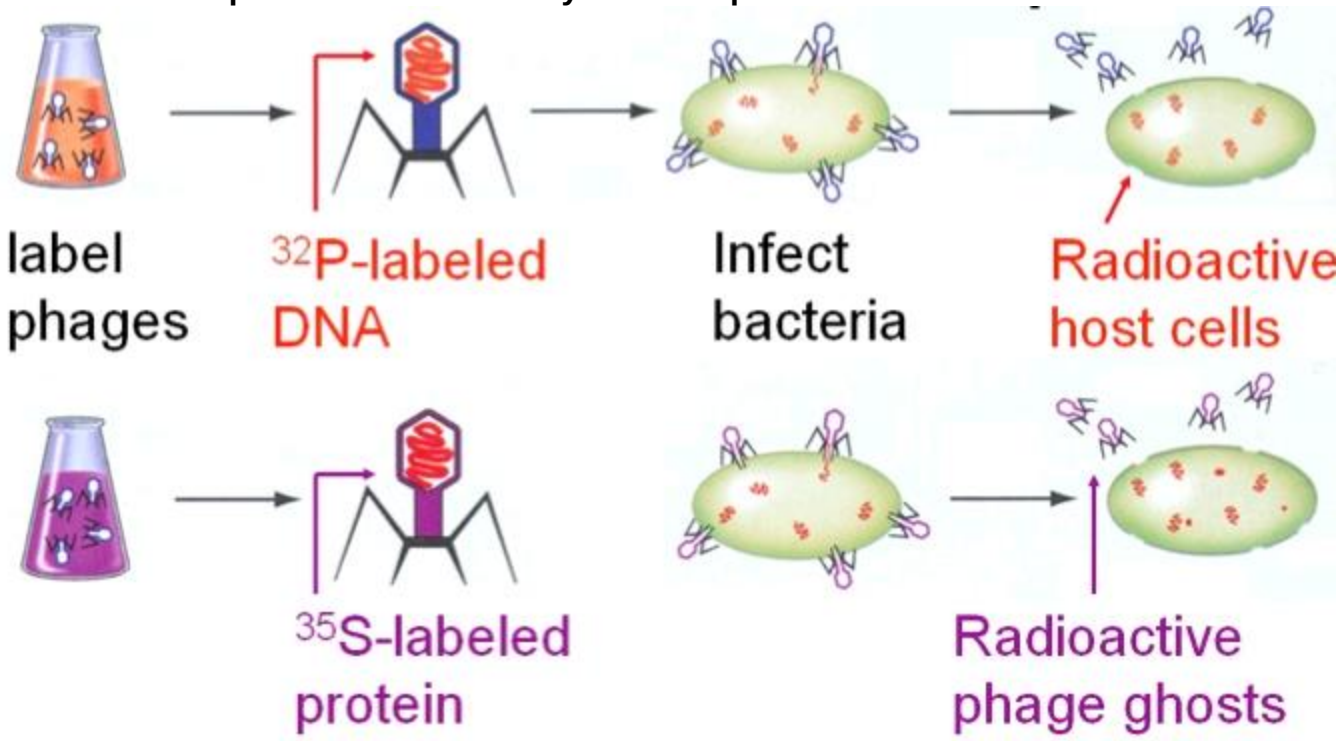


2. List the structural differences that you observe between purines and pyrimidines.

E. NUCLEAR CHEMISTRY AND RADIOACTIVITY.

In 1952, a famous experiment was conducted by Alfred Hershey and Martha Chase at the Cold Spring Harbor Laboratory. Their goal was to confirm that DNA was in fact the genetic material and not the protein molecule as many scientists assumed due to the complexity of proteins. They used two radioisotopes in the experiment as shown in the diagram below. Note: a phage is a virus that infects and replicates in a bacterial cell.

1. Complete the chart by stating the number of protons, neutrons and electrons in each radioisotope used in the Hershey-Chase experiment



Radioisotope	# protons	# neutrons	# electrons
phosphorous-32			
Sulfur-35			

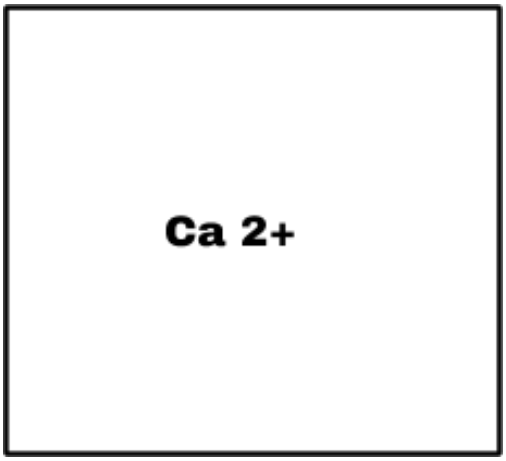
2. Why was it necessary to use radioisotopes in this experiment? (Hint: Think of a purpose of radioisotopes).

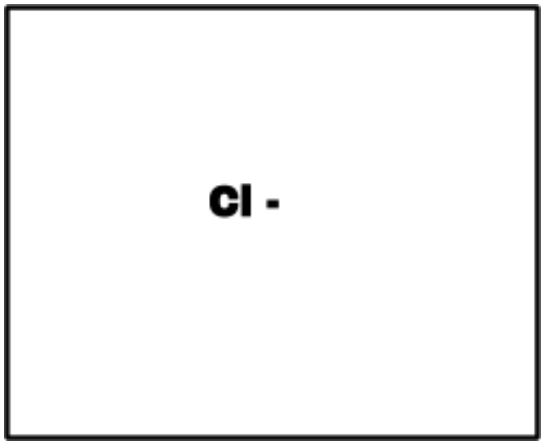
3. Why did Hershey and Chase use P-32 to label DNA but S-35 to label protein?

F. CHARACTERISTICS OF WATER

1. **Draw a Lewis dot diagram of a water molecule. Label the partial positive and the partial negative ends of the molecule. Draw second water molecule identical to and next to the first diagram. Be sure to draw the second one in the correct orientation to the first one.**

2. **Draw three molecules of water in the correct orientation around each of the ions shown below.**





3. **What is the type of intermolecular force of attraction in a sample of water?**

4. Define the following terms:

a. Specific heat

b. Heat of vaporization

c. Heat of fusion

5. What is responsible for H_2O having a boiling point of 100°C and H_2S, a molecular cousin of water, having a boiling point of -60°C?

6. The average ocean temperature in October in New York is around 65°F but the average air temperature in October in New York is around 55°F? Why does the ocean water stay warm even though the air temperature is colder?

7. All aerobic organisms require oxygen for survival. Where do we find the oxygen used by aquatic organisms?

8. What is the relationship of temperature to the amount of dissolved oxygen in the oceans? Explain this characteristic with regard to the solubility of a gas dissolved in a liquid. (Hint: think about the gas laws).