AP Biology Summer Assignment 2019

Welcome to AP biology. During AP biology, we are going to be generating and analyzing a lot of data of all sorts. You will need a solid foundation in reading and understanding data sets. This summer assignment is meant to provide you with this foundation to get you started on an exciting year of learning. ← (that sounds lame but I am seriously excited.) This will be due **Friday August 23rd.**

There are three parts to the summer assignment. All students enrolled MUST complete Part I and then either Part II or Part III. If you HAVE taken AP Chemistry then you may choose between Part II OR Part III. If you HAVE NOT had AP Chemistry then you MUST complete Part II. This assignment reviews the skills that are necessary in order to understand even the most basic sections of this class.

Part I: Join Class & Complete the survey – ALL students!!

Google Classroom – Class Code: 26qub2

https://goo.gl/forms/OhUeWHMMHaHxpFv93

Part II: Any student who has not had AP Chemistry MUST complete Part II.

Please read all of the information in this packet and complete the exercises/answer the questions that follow. There is no need to turn in the informational portion of the packet or your personal notes, only the pages where you write your answers need to be submitted.

Review A: Parts of an Experiment

You are probably already familiar with the different parts of an experiment, so this is just meant to be a quick refresher. The two most important variables in an experiment are the independent variable and the dependent variable. The independent variable is the thing you are changing between your experimental groups, the variable that you manipulate. The dependent variable is the outcome of the experiment; it is the variable that you measure. No other variables should be changed between your groups. The variables that you don't change are called constants.

Something that often confuses students is the difference between a control group and a constant, which is sometimes called a control variable. The control group is a group in your experiment that sets a baseline for comparison. You can think of it as the "default" or the "normal" state for what you are testing. For example, if you wanted to see how different colored light affected plant growth, you would compare your colors to "normal" plant growth, which would be growth under sunlight. Likewise, if you were testing to determine the effectiveness of a new drug, you would compare the effects of the drug to people who hadn't been given a drug, people in their "normal" state.

A constant variable, on the other hand, is something that you keep constant in all of the experimental groups. In your light experiment, it would be important to keep all variables besides the light color constant, variables like fertilizer, water, light intensity, etc. This is to make sure that any effects that you observe in your experiment are actually caused by your independent variable. Part of the reason that constants and controls are often confused is because when we talk about constant variables, we often say that we "controlled for" them. This means that we paid attention to keeping them constant, not that they are our control group.

Review B: Tables

A student team performed the experiment. They tested the pulse and blood pressure of basketball players and nonathletes to compare cardiovascular fitness. They recorded the following data:

Nonathletes							**Basketball Players**						
	Resting pulse			**After exercise**				**Resting pulse**			**After exercise**		
	Trial			**Trial**				**Trial**			**Trial**		
Subject	**1**	**2**	**3**	**1**	**2**	**3**	**Subject**	**1**	**2**	**3**	**1**	**2**	**3**
1	72	68	71	145	152	139	**1**	67	71	70	136	133	134
2	65	63	72	142	144	158	**2**	73	71	70	141	144	142
3	63	68	70	140	147	144	**3**	72	74	73	152	146	149
4	70	72	72	133	134	145	**4**	75	70	72	156	151	151
5	75	76	77	149	152	153	**5**	78	72	76	156	150	155
6	75	75	71	154	148	147	**6**	74	75	75	149	146	146
7	71	68	73	142	145	150	**7**	68	69	69	132	140	136
8	68	70	66	135	137	135	**8**	70	71	70	151	148	146
9	78	75	80	160	155	153	**9**	73	77	76	138	152	147
10	73	75	74	142	146	140	**10**	72	68	64	153	155	155

If the data were presented to readers like this, they would see just lists of numbers and would have difficulty discovering any meaning in them. This is called **raw data**. It shows the data the team collected without any kind of summarization. Since the students had each subject perform the test three times, the data for each subject can be averaged. The other raw data sets obtained in the experiment would be treated in the same way.

Table 1. Average Pulse Rate for Each Subject
(Average of 3 trials for each subject; pulse taken before and after 5-min step test)

Nonathletes			Basketball Players		
	Resting pulse	After exercise		Resting pulse	After exercise
Subject	Average	Average	Subject	Average	Average
1	70	145	1	70	134
2	67	148	2	70	142
3	67	144	3	73	149
4	71	139	4	72	151
5	76	151	5	76	155
6	74	150	6	75	146
7	71	146	7	69	136
8	68	136	8	70	146
9	78	156	9	76	147
10	74	143	10	68	155

Commented [EL1]: Notice the way this table is titled. The title is above the table and the table is numbered. There is also a descriptive title that explains the data in the table. This is the way tables are titled in scientific documents.

These rough data tables are still rather unwieldy and hard to interpret. A summary table could be used to convey the overall averages for each part of the experiment. For example:

Table 2. Overall Averages of Pulse Rate
(10 subjects in each group; 3 trials for each subject; pulse taken before and after 5-min step test)

Commented [EL2]: Notice that there is a brief description of how the data was generated. This is not always included, but can be helpful if the table is shown out of context of a whole lab write-up.

Pulse Rate (beats/min)		
	Before exercise	After exercise
Nonathletes	71.6	145.8
Basketball players	71.9	146.1

Notice that the table has a title above it that describes its contents, including the experimental conditions and the number of subjects and replications that were used to calculate the averages. In the table itself, the units of the dependent variable (pulse rate) are given and the independent variable (nonathletes and basketball players) is written on the left side of the table.

Tables should be used to present results that have relatively few, data points. Tables are also useful to display several dependent-variables at the same time. For example, average pulse rate before and after exercise, average blood pressure before and after exercise, and recovery time could all be put in one table.

Review C: Graphs

Numerical results of an experiment are often presented in a graph rather than a table. A graph is literally a picture of the results, so a graph can often be more easily interpreted than a table. Generally, the independent variable is graphed on the x-axis (horizontal axis) and the dependent variable is graphed on the y-axis (vertical axis). In looking at a graph, then, the effect that the independent variable has on the dependent variable can be determined.

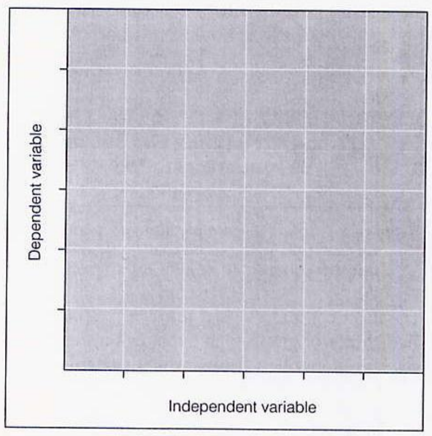


Figure 2.5.
Graph construction.

When you are drawing a graph, keep in mind that your objective is to show the data in the clearest, most readable form possible. In order to achieve this, you should observe the following rules:

- Use graph paper to plot the values accurately
- Plot the independent variable on the x-axis and the dependent variable on the y-axis. For example, if you are graphing the effect of the amount of fertilizer on peanut weight, the amount of fertilizer is plotted on the x-axis and peanut weight is plotted on the y-axis.
- Label each axis with the name of the variable and specify the units used to measure it. For example, the x-axis might be labeled "Fertilizer applied (g/100 m2)"' and the y-axis might be labeled "Weight of peanuts per plant (grams)."
- The intervals labeled on each axis should be appropriate for the range of data so that most of the area of the graph can be used. For example, if the highest data point is 47, the highest value labeled on the axis might be 50. If you labeled intervals on up to 100, there would be a large unused area of the graph.

- The intervals that are labeled on the graph should be evenly spaced. For example, if the values range from 0 to 50, you might label the axis at 0, 10, 20, 30, 40, and 50. It would be confusing to have labels that correspond to the actual data points (for example, 2, 17, 24, 30, 42, and 47).
- The graph should have a title that, like the title of a table, describes the experimental conditions that produced the data.

***You will have to draw at least one graph in the Free Response Section of the AP test.**

Figure 2.6 illustrates a well-executed graph. Notice how the graph is titled. The title is at the **bottom** of the graph. The graph is labeled as a Figure and titled with a sentence that describes the data.

Figure 2.6.
Graph of peanut weight vs. amount of fertilizer applied.

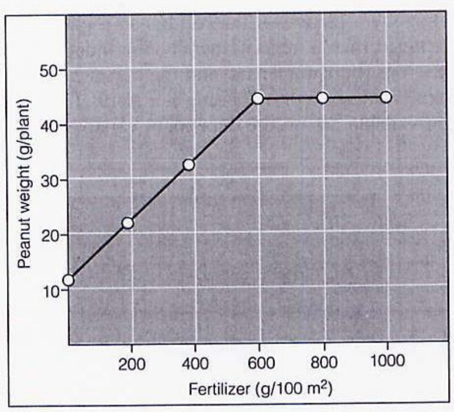


Figure 1. Weight of peanuts produced per plant when amount of fertilizer applied is varied. (Average seed weight per plant in 100 m^2 plots, 400 plants/plot.)

The most commonly used forms of graphs are line graphs and bar graphs.

*While this assignment does not give any examples of Pie Charts, they are also very useful tools for presenting data that represents percentages or relative amounts of something. They are not considered graphs because they do not plot independent and dependent variables against each other.

The choice of graph type depends on the nature of the <u>independent</u> <u>variable</u> being graphed.

Continuous variables are those that have an unlimited number of values between points. Line graphs are used to represent continuous data. For instance, time is a continuous variable over which things such as growth will vary. Although the units on the axis can be minutes, hours, days, months, or even years, values can be placed in between any two values. Amount of fertilizer can also be a continuous variable. Although the intervals labeled on the x-axis are 0, 200, 400, 600, 800, and 1000 (g/100 m2), many other values can be listed between each two intervals.

In a line graph, data are plotted as separate points on the axes, and the points are connected to each other. Notice in Figure 2.7 that when there is more than one set of data on a graph, it is necessary to provide a key indicating which line corresponds to which data set. On the graph, the key is shown on the graph, but legend information can sometimes be shown under the graph after the title.

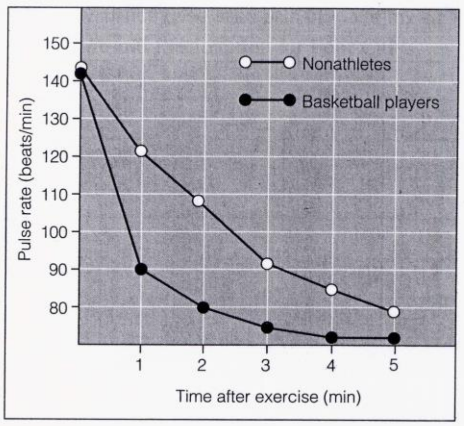


Figure 1. Recovery rate of basketball players and nonathletes after performing a step test for 5 minutes. (Average of 10 subjects; each subject performed the test 3 times.)

Figure 2.7. Line graph representing two related sets of data.

Discrete variables, on the other hand, have a limited number of possible values, and no values can fall between them. For example, the type of fertilizer is a discrete variable: There are a certain number of types which are distinct from each other. If fertilizer type is the independent variable displayed on the x-axis, there is no continuity between the values. Discrete variables are categories and are often non-numerical.

Bar graphs, as shown in Figure 2.8, are used to display discrete data.

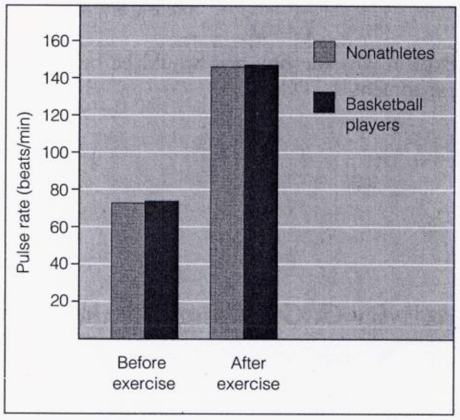


Figure 1. Average pulse rates of basketball players and nonathletes before and after performing a step test for 5 minutes. (Average of 10 subjects; each subject performed the test 3 times.)

Figure 2.8.
Example of bar graph.

In this example, before- and after-exercise data are discrete: There is no possibility of intermediate values. The subjects used (basketball players and nonathletes) also are a discrete variable (a person belongs to one group or the other).

This graph could also have been constructed as shown in Figure 2.9.

Figure 2.9.
Alternative method of presenting data in Figure 2.7.

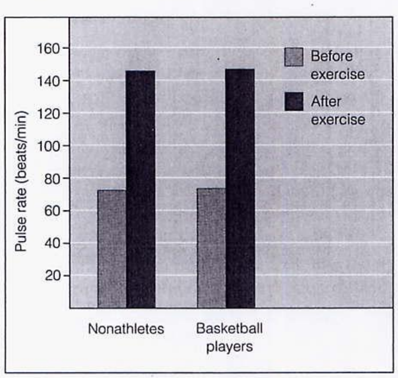


Figure 1. Average pulse rates of basketball players and nonathletes before and after performing a step test for 5 minutes. (Average of 10 subjects; each subject performed the test 3 times.)

Review A-C Questions: Answer the following questions (turn in this part)

1. What is the difference between the two graphs (figures 2.8 and 2.9) in section Activity D: Graphing?

2. Figures 2.7-2.9 show the data generated by the experiment explained in Activity C: Tables. Which graph would be best to convey the results of this experiment? Explain why.

3. What can you infer from these results?

***In the following questions you will be sketching graphs without plotting data. By practicing how to construct graphs, you will learn how to graph your own data in later labs. Use the regularity and size intervals to determine if a variable is continuous or discrete.**

1. A team of students hypothesizes that the amount of alcohol produced in fermentation depends on the amount of sugar supplied to the yeast. They want to use 5, 10, 15, 20, 25, and 30% sugar solutions. They propose to run each experiment at 40°C with 5 mL of yeast.
   a. What are the independent and dependent variables of this experiment?

   b. What variables have the experimenters kept constant?

   c. What type of graph is appropriate for presenting these data? Explain why.

   d. Sketch the axes of a graph that would present these data. Mark the intervals on the x-axis and label both axes completely. Write a title for the graph.

2. Having learned that the optimum sugar concentration is 25%, the students next decide to investigate whether different strains of yeast produce different amounts of alcohol.
   a. If you were going to graph the data from this experiment, what type of graph would be used? Explain why.

   b. Sketch and label the axes for this graph and write a title.

3. A team of students wants to study the effect of temperature on bacterial growth. They put the dishes in different places: an incubator (37°C), a lab room (21°C*)*, a refrigerator (10°C) and a freezer (0°C). Bacterial growth is measured by estimating the percentage of each dish that is covered by bacteria at the end of a 3-day growth period.
   a. What are the independent and dependent variables of this experiment?

   b. What variables have the experimenters kept constant?

   c. What type of graph is appropriate for presenting these data? Explain why.

   d. Sketch the axes of a graph that would present these data. Mark the intervals on the x-axis and label both axes completely. Write a title for the graph.

4. A group of students decides to investigate the loss of chlorophyll in autumn leaves. They collect green leaves and leaves that have turned color from sugar maple, sweet gum, beech, and aspen trees. Each leaf is subjected to an analysis to determine how many mg of chlorophyll is present.
    a. What are the independent and dependent variables of this experiment?

    b. What variables have the experimenters kept constant?

    c. What type of graph is appropriate for presenting these data? Explain why.

    d. Sketch the axes of a graph that would present these data. Mark the intervals on the x-axis and label both axes completely. Write a title for the graph.

Graphing Practice

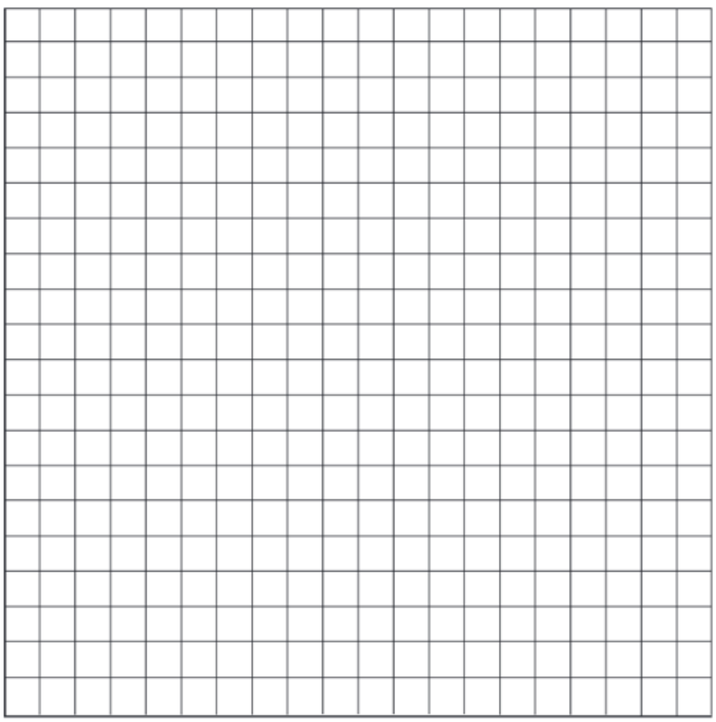
Use the temperature and precipitation data provided in Table 2.6 to complete the following questions:

Table 2.6
Average Monthly High Temperature and Precipitation for Four Cities
(T = temperature in °C; P = precipitation in cm)

		Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
Fairbanks, Alaska	**T**	-19	-12	-5	6	15	22	22	19	12	2	-11	-17
	P	2.3	1.3	1.8	0.8	1.5	3.3	4.8	5.3	3.3	2.0	1.8	1.5
San Francisco, California	**T**	13	15	16	17	17	19	18	18	21	20	17	14
	P	11.9	9.7	7.9	3.8	1.8	0.3	0	0	0.8	2.5	6.4	11.2
San Salvador, El Salvador	**T**	32	33	34	34	33	31	32	32	31	31	31	32
	P	0.8	0.5	1.0	4.3	19.6	32.8	29.2	29.7	30.7	24.1	4.1	1.0
Indianapolis, Indiana	**T**	2	4	9	16	22	28	30	29	25	18	10	4
	P	7.6	6.9	10.2	9.1	9.9	10.2	9.9	8.4	8.1	7.1	8.4	7.6

Source: Pearce, E. A., and G. Smith. Adapted from *The* Times *Books World Weather* Guide. New York: Times Books, 1990.

1. On the axis provided, create an appropriately labeled graph comparing monthly temperatures in Fairbanks with temperatures in San Salvador. Use the following questions to help you make sure your graph contains all appropriate information.
   Can data for both cities be plotted on the same graph?
   What will go on the x-axis?
   How should the x-axis be labeled?
   What should go on the y-axis?
   What is the range of values on the y-axis?
   How should the y-axis be labeled?
   What type of graph should be used?

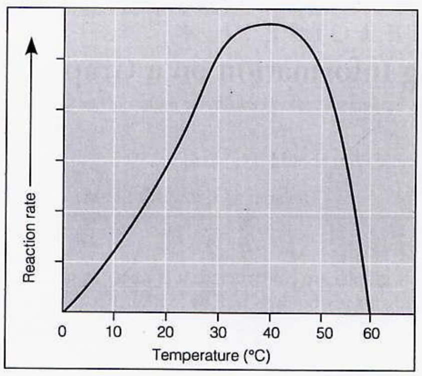


Practice Interpreting Graphs

Once you understand how graphs are constructed, it is easier to get information from the graphs in your textbook as well as to interpret the results you obtain from laboratory experiments. For the graphs below answer the questions that follow.

* Remember that Rate = amount / time.   The slope of a line will often tell you the rate.

Figure 2.11.
Rate of an enzymatic reaction at different temperatures.



1. Interpret this graph: What patterns or trends to you see?

2. At what temperature is reaction rate the highest?

3. In this experiment do temperature and reaction rate have a linear relationship?

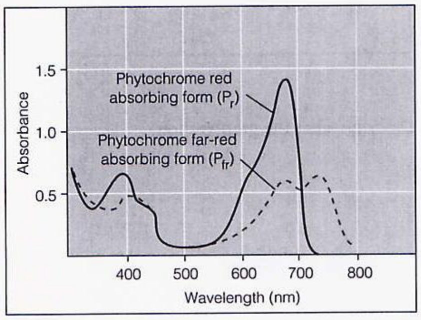


Figure 2.13. Absorption of light by the pigments P_r phytochrome and P_{fr} phytochrome.

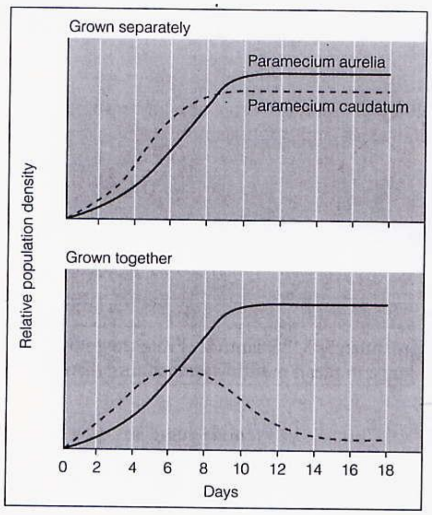
Please note that the y-axis has no "units". Absorbance is a type of measurement used in spectroscopy that we will discus in great detail later this year.

4. Interpret this graph: What patterns or trends to you see?

5. At what wavelengths does P_r phytochrome absorb the most light?

6. At what wavelengths does P_{fr} phytochrome absorb the most light?

Figure 2.14.
Population growth of *Paramecium aurelia* and *Paramecium caudatum* when grown separately and together.



7. Interpret these graphs: What patterns or trends to you see?

8. On what day does *Paramecium aurelia* reach its maximum population density when grown alone?

9. What happens to *Paramecium caudatum* when it is grown in a mixture with *Paramecium Aurelia* compared to when it is grown alone?

Review D: Basic Chemistry

During the 1st quarter we will jump right in and learn about biological molecules. We will not take time to review the basic chemistry that you have already learned. Your assignment is to review the chemistry you will need upon entering AP Biology.

Instructions: Search YouTube for **<u>"Basic Chemistry Concepts Part I" by ThePenguinProf</u>**, and watch BOTH parts I and II. Take notes on information that is new to you (If you just finished chemistry and this is all familiar, no notes are needed). If you are not confident in chemistry, I recommend watching the first several videos in the "Crash Course Chemistry" series as well.

1. Which 4 elements are most common in living organisms?

2. Using the partial periodic table to the right, fill in the table below. Atomic numbers are above each element's symbol, atomic masses are below. Round each atomic mass to the nearest whole number.

boron 5 **B** 10.811	carbon 6 **C** 12.011	nitrogen 7 **N** 14.007	oxygen 8 **O** 15.999	fluorine 9 **F** 18.998	neon 10 **Ne** 20.180
aluminium 13 **Al** 26.982	silicon 14 **Si** 28.086	phosphorus 15 **P** 30.974	sulfur 16 **S** 32.065	chlorine 17 **Cl** 35.453	argon 18 **Ar** 39.948
gallium 31 **Ga** 69.723	germanium 32 **Ge** 72.61	arsenic 33 **As** 74.922	selenium 34 **Se** 78.96	bromine 35 **Br** 79.904	krypton 36 **Kr** 83.80
indium	tin	antimony	tellurium	iodine	xenon

Atom	Atomic Number	Atomic Mass	Protons	Neutrons	Electrons
Be	4	9	4	5	4
C					
Al					
Cl^{-1}					

3. Deuterium is an isotope of hydrogen with an atomic mass of 2. Normal hydrogen atoms have an atomic mass of 1.

a) How many protons does deuterium have? ______________

b) How many neutrons? __________________

4. Draw the Lewis Dot Structure for the following elements:

a) C^6

b) H^1

c) O^8

d) N^7

5. For each of the elements in the previous question, how many covalent bonds will an atom of this element tend to make?

6. Why (in terms of protons, neutrons, and/or electrons) are Neon and Argon considered **inert** or **unreactive**?

7. Write several sentences relating the meanings of the following terms: element, atom, compound, molecule, ion

8. When an atom or compound becomes **ionized**, it has gained or lost: __________________

9. Consider these three types of bonds: hydrogen, ionic, covalent.

A) Which bond is the strongest of the three? What makes it so strong?

B) Which bond is intermediate in terms of strength? Why is it weaker than the strongest?

C) Which bond is the weakest? Why?

10. H_2O is water. Which type of atom in water (H or O) would have more of a negative charge, and why?

- What type of covalent bond is found in water?

11. Explain the importance of each of the properties of water and how they relate to life on earth.

- High Polarity
- High-Specific Heat
- High heat of vaporization
- Cohesion and Adhesion
- Low density of Ice
- Solvent of Life

12. Which of these substances would contain a triple covalent bond? N_2, CO_2, H_2, O_2

- Why does it contain a triple covalent bond?

13. Draw the Lewis Dot structures for Carbon (atomic number = 6) and Hydrogen (atomic # = 1).

How many hydrogen atoms would need to bond covalently with one carbon to make all the atoms happy?

Would these covalent bonds be more or less polar than the bonds in water (H_2O)?

14. H^+ (hydrogen with a charge of +1) is more commonly known as "a proton". Explain why, describing this ion's number of protons, neutrons, and electrons.

<u>Instructions for Video #2:</u> Google "How radioactive isotopes track biological molecules". Watch the video and answer the following questions:

15. What is a radioactive isotope?

16. Explain in your own words how radioactive isotopes can be used to determine whether phosphorus is a component of DNA or of protein.

ONE FINAL QUESTION

1. What do you think science is? Don't look it up or give me the text book definition. I want you to explain your own understanding of science. This should take you a bunch of sentences.

Part III: Any student who has had AP Chemistry may choose to complete Part III instead of Part II.
Choose ONE book from the following list to read over the summer and complete a 3+ page review of the book that you read. The review must include a summary and a personal commentary/reaction to the book as well as your final recommendation on whether you would recommend the book to someone else. *NOTE: *** Denotes that I have read AND RECOMMEND this book!*

The Demon-Haunted World by Carl Sagan ***
A book about what science really is, and how the scientific method fights ignorance and superstition. Very well written, and probably an enjoyable read for anyone.

Origin of the Species (Any Version) by Charles Darwin
A boring book on evolution, but the tried and true original. Read an abbreviated version if you can find one, the regular one talks way too much about pigeons. Or, just read a different book.

The Beak of the Finch by Jonathan Weiner ***
A book about the Finches of the Galapagos Islands and evolutions. A thousand times better than Origin of the Species.

Silent Spring by Rachel Carson
A very famous book documenting the effect of indiscriminate pesticide use on the environment. Recommended by The Times magazine and mentioned in the 2003 AP Bio Exam and the Bio SAT II.

Your Inner Fish: A Journey into the 3.5-Billion-Year History of the Human Body by Neil Shubin ***
Awesome read, highly recommended by biologists everywhere. Shubin chairs the department of Organismal Biology and Anatomy at the University of Chicago and was co-discoverer of Tiktaalik, a 375-million-year-old fossil fish whose flat skull and limbs, and finger, toe, ankle, and wrist bones, provide a link between fish and the earliest land-dwelling creatures.

The Book of Life: An Illustrated History of the Evolution of Life on Earth by Stephen Jay Gould (Editor)
A lucid, readily comprehensible, and largely up-to-date overview of the origins and evolution of life on earth, from the emergence of bacteria billions of years ago, to that of Homo sapiens in recent geological time. Written by distinguished scientists, the text is chronological and gives and in-depth account of the fossil record including hundreds of paintings, drawings, charts, and graphs that reinforce the authors' discussions.

The Seven Daughters of Eve: The Science That Reveals Our Genetic Ancestry by Bryan Sikes
Sykes relates personal and historical anecdotes, offering familiar ground from which to consider the science behind tracing a path of human evolution. A discussion of genetic history and descriptions of early landmark work by Sykes and his associates culminate with his finding that 90% of modern Europeans are descendants of just seven women who lived 45,000 to 10,000 years ago.

Genome: The Autobiography of a Species in 23 Chapters by Matt Ridley
Each chapter pries one gene out if its chromosome and focuses on its role in development. The book also explores implications of genetic research and our quickly changing social attitude toward this information. It shies away from "tedious biochemical middle managers" that only a nerd could love and goes straight for the A-material: genes associated with cancer, intelligence, sex, and more.

The Hot Zone: A Terrifying True Story by Richard Preston ***
A dramatic and chilling story of an Ebola virus outbreak in suburban Washington, D.C. laboratory, with descriptions of the frightening historical epidemics of rare and lethal viruses. Seriously terrifying, suspenseful, and excellently written!

The Demon in the Freezer by Richard Preston ***
Another "killer" by Preston written about the most deadly human virus, smallpox. After its eradication in 1979, it was confined to freezers located in just two places on earth: the Center for Disease Control in Atlanta and the Maximum Containment Laboratory in Siberia. Since the fall of the Soviet Union in 1991, a sizeable amount of the smallpox stockpile remains unaccounted for, leading to fears that it could have fallen into the hands of nations or terrorist groups.