Name: ______________________________

AP Biology Summer Assignment

Ms. Svedberg - Montverde Academy

Welcome to AP Biology!

I am so excited that you have decided to take this class. AP Biology is a college-level course that covers a variety of topics including everything from the molecules inside cells, to the workings of whole organisms, to the interactions within ecosystems. The course is organized into 8 units: **Chemistry of Life**, **Cell Structure and Function**, **Cellular Energetics**, **Cell Communication and Cell Cycle**, **Heredity**, **Gene Expression and Regulation**, **Natural Selection**, and **Ecology**, with a bonus Unit 0 (**Scientific Method**). In the course, we will also focus on the mastery of scientific practices (skills). The exam at the end of the year will ask you to demonstrate that mastery with regard to the topics of each unit.

Part 1: Scientific Practices

Let's first look at different science skills you will need to be successful in AP Biology.

1. Go to this website. Watch the videos on **AP Biology Practices**. Take notes on each of the Biology Practices
    - Models & Representation
    - Using Mathematics
    - Scientific Questioning
    - Data Collection Strategies
    - Analysis and Evaluation of Evidence

- Scientific Explanations & Theories

- Scales, Concepts, & Representations

2. Watch the following video and answer the questions. Bozeman - A Beginner's Guide to Graphing
    a. What type of graph uses a "best fit" line?
    b. Explain the difference between a bar graph and a histogram.
    c. What type of graph shows change over time?
    d. What type of graph displays a correlation of variables?
    e. Distinguish between the independent variable and dependent variable and where they are placed on a graph.
    f. Which type of graph is best for comparing 2 or more different groups?
    g. Which type of graph is better for showing distribution of data?
    h. Explain when a pie graph should be used and give (draw) any example.
    i. State at least 5 elements that any graph should always display.
3. Watch the following video and answer the questions. Bozeman - Statistics for Science
    a. What is n?
    b. What is x (bar)?

c. What is M?

d. What was the range of the sample he gave?

e. Explain “Degrees of Freedom” (with any example) and why the formula is n-1.

4. Watch the following video and answer the questions. [Bozeman - Standard Deviation]
   a. What is meant by normal distribution?

   b. What does standard deviation (SD) measure?

   c. Can 2 sets of data have the same mean but a different SD? Explain.

   d. 1 SD means _____% of the population falls within this range; while 2 SD means _____% falls in this range.

Part 2: Data Analysis and Graphing Information

Read through the following information to learn about data analysis.

A student team performed the experiment. They tested the pulse of basketball players and non-athletes 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.

Let's average the 3 trials for each subject, still showing the pulse taken before and after the 5 minute exercise.

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

This is better, showing a clearer version of the data. However, it is still rather cumbersome. We can create a summary table to show overall averages. Let's do that.

Table: Overall Averages of Pulse Rate
(10 subjects per group; 3 trials for each subject; pulse taken before and after exercise)

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

Much better! 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.

Now, let's look at how we develop some 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 and therefore can 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, the effect that the independent variable has on the dependent variable can be determined.

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 follow these 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 would be on the x-axis and peanut weight would be 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/100m^2)” and the y-axis might be “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 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.

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

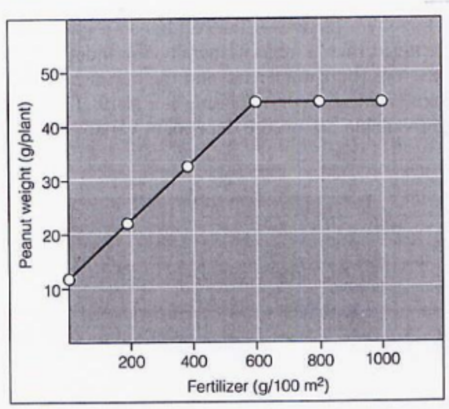


Figure 1. Weight of peanuts produced per plant when amount of fertilizer applied is varied. (Average seed weight per plant in 100 m^2 plots, 400 plants/plot.)

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

But what type of graph should I use?

- **Line graphs** are used to represent continuous data. **Continuous variables** are those that have an unlimited number of values between points. For instance, time is a continuous variable over which things vary. Although the units on the axis can be **minutes, hours, days, months, or 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, and 600, many other values can be listed between these intervals.
  In a line graph, data are plotted at **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.

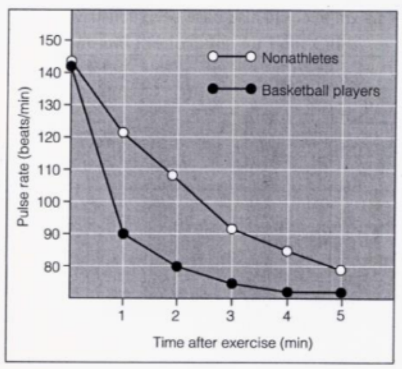


Figure 1. Recovery rate of basketball players and nonathletes after performing a step test for 5 minutes. (Average of 10 subjects; each subject performed the test 3 times.)

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

- **Bar graphs** are used to display discrete data. **Discrete variables** have a limited number of possible values, and no values can fall between them. For example, **exercise** is a discrete variable. In Figure 2.8 and Figure 2.9, before exercise and after exercise are distinct from each other with no continuity between the values.

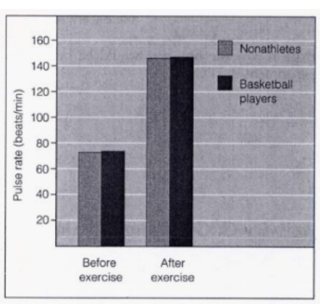


Figure 1. Average pulse rates of basketball players and nonathletes before and after performing a step test for 5 minutes. (Average of 10 subjects; each subject performed the test 3 times.)

Figure 2.8. Example of bar graph.

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

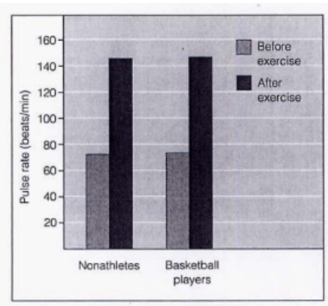


Figure 1. Average pulse rates of basketball players and nonathletes before and after performing a step test for 5 minutes. (Average of 10 subjects; each subject performed the test 3 times.)

1. What is the difference between the graphs in Figure 2.8 and Figure 2.9?

2. Which way would be better to convey the results of the experiment?

3. What can you infer from these results?

Part 3: Graphing Practice

Put into practice what you have just reviewed in Part 2. Answer the questions for each set of data.

1. Use the temperature and precipitation data provided in Table 2.6 to compare monthly temperatures for Fairbanks, San Francisco, San Salvador, and Indianapolis.

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

a. Can data for all cities be plotted on the same graph?

b. What would go on the x-axis?

c. How should the x-axis be labeled?

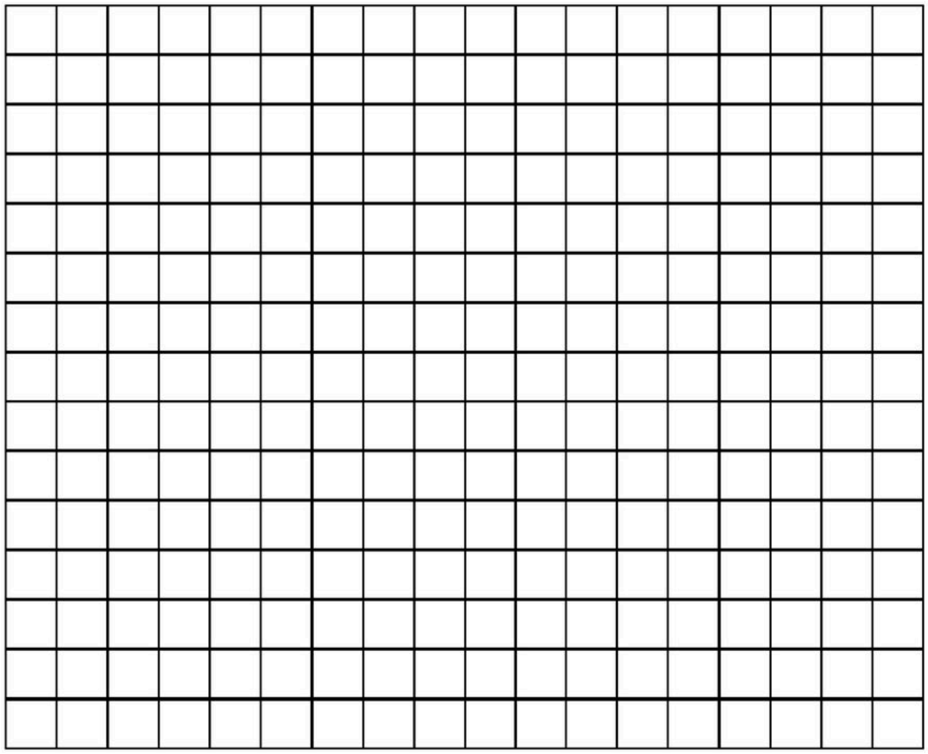
d. What would go on the y-axis?

e. What is the range of values on the y-axis?

f. How should the y-axis be labeled?

g. What type of graph should be used?

h. Graph the data on the axes below.



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

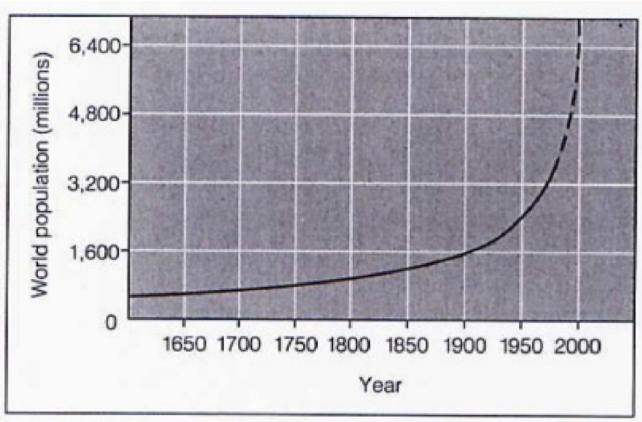


Figure 2.10.
Change in world population from 1650 to 2000.

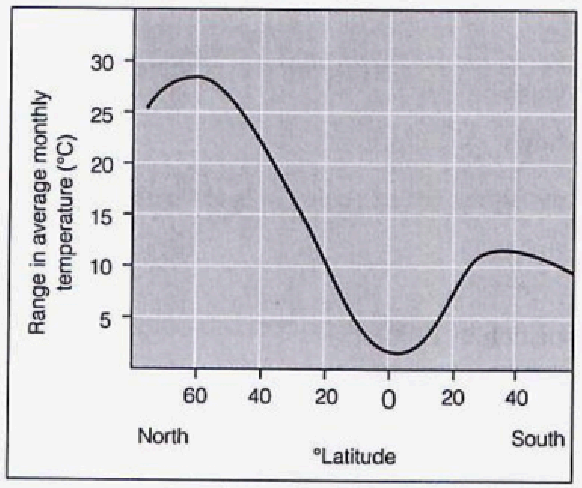
2. Interpret this graph. What patterns or trends do you see?

3. What was the world's population in 1900?

4. Predict the world's population in 2000.

5. Why does this graph change from a solid line to a dashed line at the end?

Figure 2.12.
Change in range of average monthly temperature as latitude changes.



6. Interpret this graph. What patterns or trends do you see?

7. At what latitudes does the least variation in temperature occur?

8. Miami is at approximately 26° N latitude. From the information on the graph, what is the range in mean monthly temperature there?

9. Minneapolis is at approximately 45° N latitude. From the information on the graph, what is the range in mean monthly temperature there?

10. Sydney is at approximately 33° S latitude. From the information on the graph, what is the range in mean monthly temperature there?

11. Look at any map of the world and explain the temperature patterns in the graph.