Hello and welcome to AP/CCP Biology! My class is highly intensive, with a lot of material that needs to be covered. The course is designed to be a 2 semester college course, with a lecture and lab, for a total of 10 earned college credits.

Please be aware that part of taking this class is a commitment to being on time, on task, and hard working. Although AP Biology is a huge commitment, we will have a lot of fun. I look forward to working with each one of you next year! Here are a few items of interest before you get started on the summer assignment.

I know the words "summer assignment" tends to send chills down any high school student's spine, but I think that you will find that this assignment will be very beneficial to you as we start the school year in the fall. The reason I am giving you a summer assignment is to keep your mind sharp and thinking, so you are ready to hit the ground running!

First, I would like to know a little about who you are so your first assignment is to complete the survey below:

Assignment 1 Introductory Survey (18 pts)

1. Please include your full name (& nickname that you go by if you have one).

2. In a word, describe school. If you were at Benedictine high school last year, describe our school.

3. What other science classes have you taken? Are planning to take next year?

4. What do you like to do (hobbies, sports, music, interests, etc.)?

5. Do you have a job or plan on getting a job next year? What kind?

6. What are your personal strengths when it comes to learning new material?

7. What causes you to struggle in a course?

8. What is the most effective way for you to prepare for a test?

9. How many AP classes have you taken so far? How many have you passed with a 3 or higher?

10. How did you feel about Biology as a class when you took it previously? Chemistry?

11. What is the most important thing I need to do as a teacher to help you succeed in our class?

12. Is there anything that I should know to help keep you safe (any allergies, medical conditions, etc)?

13. In case of emergency, my parent(s)/guardian(s) may be reached at (phone #)

    ________________________ or _________________________

Fill in your class schedule (for the entire year): (2 pts) *What I am interested in here is how overloaded you are, how many honors/AP etc.*

Course Name	Teacher (if known)	Room (if known)	Period

14. Looking at your schedule above, are you prepared to spend ~twice the amount of time on this class as you will on all your non-AP classes? *remember, 10 college credits*

15. What do you want to do after you graduate from high school?

16. How will this class assist you with your academic goals?

Assignment 2: Summer Reading (Chapter 1 in AP Biology textbook)
This will require you to log in to the online text website, a separate email has been sent to all of you and includes directions for how to get access to your book website. In order to access this assignment, you will need to log in to the textbook, use the link that I sent you to do this, enter in your personal information and the access code I gave you. Then you should see this below:

Click on the blue part at the bottom to access the assignment. It should bring you to a page where you can access LearnSmart. Click on learnsmart and the the Chapter 1 assignment. The book with highlighted sections will appear, you will read through the sections and it will prompt you to answer multiple choice questions in the practice. Keep answering until you get to the end of the chapter, then submit.
This is graded on effort only, please read through all the sections, answering the questions.
(**25 pts**).
The main point of this assignment is to successfully log in to the online book, please do not wait until the first day of class to try this, this way we can address any technical problems you may have with the website, etc over the summer.

Assignment 3: Please log in to Quia, and email me a screenshot showing me that you did so. quia.com/web
Your username and password for Quia will be included in a separate individual email, do not share your information with others. Keep this information with the book login password, etc., I recommend a file on your computer.
5 pts

Assignment 4: This is the most intensive part of the summer assignment but it is critical for your success in AP Bio. Our first lab will use many of these techniques and this assignment will help to prepare you. You are welcome to print this portion of the assignment--I am including a PDF version for this purpose--if you prefer to do the math by hand rather than on the computer.

AP Biology Math and Statistics
Practice Exercises (50 pts)

PART 1 – Measures of Central Tendency

Identifying what is happening in the middle of any data set often offers researchers a lot of information. Many sets of biologically derived data fit a normal curve. A normal curve shows the distribution of the range of data. If you were to measure everyone's shoe size in the class there would be a few students who wear very small shoes and a few who wear very large shoes, with most students wearing shoes somewhere near the middle of the range. The **mean**, **median**, and **mode** are the most widely used measures to describe how collected data clusters in the middle of a normal distribution (central tendency).

As a general rule use;

Mean when the data closely fits a normal curve,

Median when data are skewed to one end of the distribution or the other or when there are extreme outliers in the data,

Mode is not often used in Biological research but is valuable to identify data patterns that are bimodal.

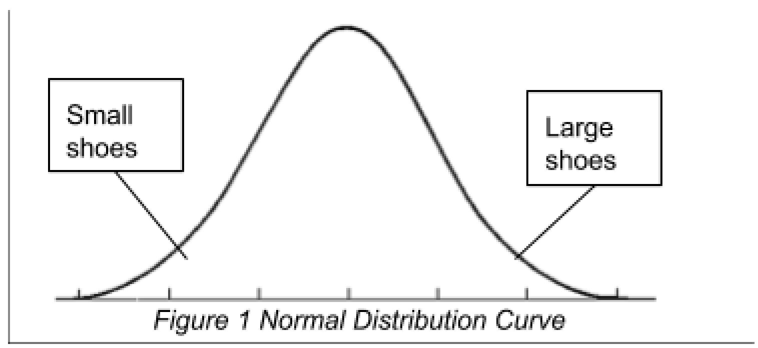


Figure 1 Normal Distribution Curve

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

Mean **(average)** = $\frac{x1 + x2 + x3 + \ldots}{n}$

$\bar{X}$ = average

N = total number of individuals in the entire population

n = total number of individuals in a sample

i = the number of measurements

$\boldsymbol{x_i}$ = any given single measurement

Σ = sum of

What this formula says is; add up all instances of the data and divide by the number of data points – but you already knew that!

Below is a table of data recorded during a behavioral study of fruit flies (scientific name *Drosophila melanogaster*). The data was taken over a 10 minute period by counting the number of flies found in two different chambers. The choice chambers were constructed by the following apparatus below. The left (treatment) chamber had a cotton ball saturated with a sugar water chosen by the students.

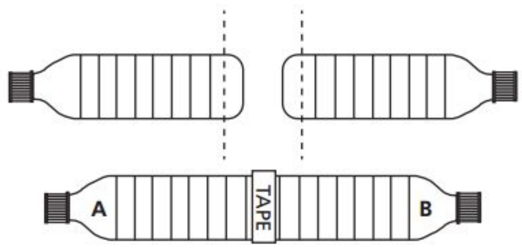


Figure 2 - Use scissors to cut the bottom of the bottles. Then, tape the bottles together using clear tape.

Time (minutes)	Number of Drosophila in right chamber	Number of Drosophila in left (treated) chamber
0	5	5
1.0	8	2
2.0	9	1
3.0	8	2
4.0	10	0
5.0	8	2
6.0	9	1
7.0	7	3
8.0	8	2
9.0	7	3
10.0	9	1

1) What is the value for ***N*** for this experiment? _______

2) What is the value for ***i*** for this experiment? _______

3) Calculate the mean of the data for both chambers over the course of the experiment.

$\bar{X}$ right chamber = _________ $\bar{X}$ left chamber = _________

(1 pt each, 4 total)

Median

The median is the data value that lies in the very middle of a set of data. Half of the data will be below the median while the other half will lie above the median. Unlike the mean, whose value may not even be represented in the data, the median is one of the data values – well, usually. In a data set with an even number of data points the median will be the average (mean) of the two central data points. The median is used when there are a few extreme values in the data set that might give an erroneous view of the central value of the data set. It has the advantage of showing what value the data set 'revolves' around.

To find the median you arrange the data points in ascending numerical order. The middle data point in this arrangement is the median.

4) What is the median of the data sets collected in the drosophila (fruit fly) experiment?

Median$_{right}$ = _______________   Median$_{left}$ = ________________

(2 pts)

Mode

The mode is the data value that occurs most frequently in a set of data. At times it may be useful to describe a data set as being bimodal. This occurs in populations that exhibit disruptive selective pressures. Neither the mean or median would show this tendency in a data set.

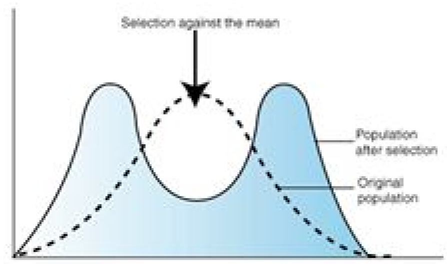


Figure 2 Bimodal distribution pattern

5) What is the mode of the data sets collected in the drosophila experiment?

Mode$_{right}$ = _______________   Mode$_{left}$ = ________________

(2 pts)

PART 2 – Measures of Variability

While the measures of central tendency show how the collected data clusters, measures of variability describe how data spreads out. These measures give an idea of the shape of the normal distribution and how much variation individual data points exhibit. **Range**, **standard deviation** and **variance** are the most widely used measures of variability.

Range

The range in a data set simply shows how far apart the smallest and largest data points are. These data values populate the two extreme tails of the full data set.

To determine the range identify the smallest data value and subtract it from the largest data value.

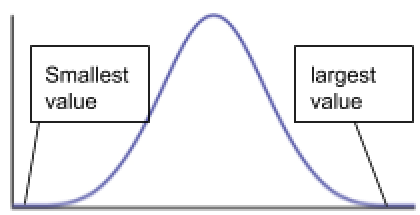


Figure 3 Data range

6) What is the range of the two data sets collected on drosophila behavior?

Range$_{right}$ = _______________   Range$_{left}$ = ________________

(2 pts)

Standard Deviation and Variance

Variance(**s^2** or **σ^2**) and standard deviation(**s** or **σ**) are two closely related measures of variability. In order to calculate the standard deviation of a data set you must first calculate the variance of the same data set. Standard deviation basically tells us how far data points deviate from the mean. You measure how far a data point is from the mean and then find the average of all of the calculated distances from the mean. The formula sheet provides the following algebraic definition:

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

Where;

s = the standard deviation

s^2 = variance

$\bar{x}$ = average

n = total number of individuals in a sample

n-1 = the degrees of freedom

i = the number of measurements

x_i = any given single measurement

Σ = sum of

7) Go ahead and calculate the variance and then the standard deviation of the drosophila data. By this time you should notice that the two sets are in essence just inverses of each other (If a fly is not in one chamber it is in the other) so if you determine the standard deviation for one side's dataset it will be the same as for the second side's set. *Remember x_i is a single data point, whereas $\bar{x}$ is the mean of the dataset.*

Number of Drosophila in right chamber	**$(x_i-\bar{x})$**	**$(x_i-\bar{x})^2$**	**Number of Drosophila in left (treated) chamber**	**$(x_i-\bar{x})$**	**$(x_i-\bar{x})^2$**
5			5		
8			2		
9			1		
9			2		
10			0		
8			2		
9			1		
7			3		
8			2		
7			3		
9			1		
$\bar{x}$ =		s^2	$\bar{x}$ =		s^2
		n-1 =			n-1 =
		s			s

Standard Deviation (***s***) = _______________ **(5 pts for completed table)**

What does the standard deviation tells us about the distribution of the data?

In a normal curve the distribution of the data is determined by the standard deviation as shown at right. 68% of the data is within one standard deviation of the mean; 95% is within 2 standard deviations of the mean; while 97% of the collected data will fall within 3 standard deviations of the mean. As the standard deviation becomes smaller the data clusters more closely to the mean. The distribution curve is therefore more closely centered about the mean (below).

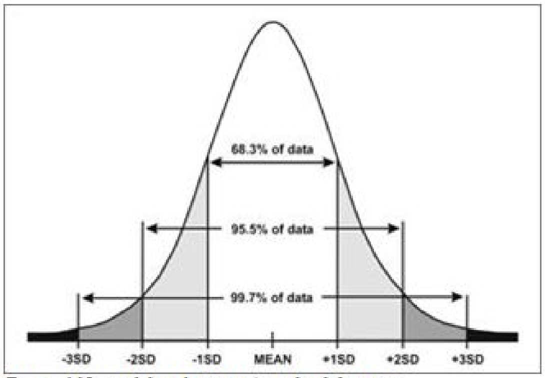


Figure 4 Normal distribution w/standard deviation

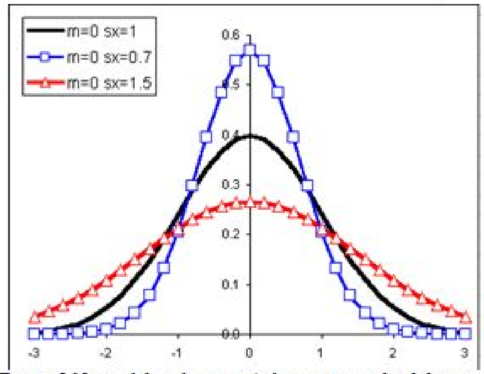


Figure 5 Normal distribution w/ changing standard deviation

PART 3 –
Measures of Confidence

When you sample a population it is just that, a sample, and may not give accurate information concerning the entire population (here a population also refers to a set of any recorded data).
Statistics provides a way to communicate how much error may have been in collected data due to sampling error. The more closely the sample size approaches the entire population the smaller the sampling error until the point where the entire population is sampled and no error is present.

Standard Error of the Mean

The standard error of the mean is a statistic that allows us to infer how well the sample mean matches up to the true population mean. If one were to take a large number of samples (at least 30) from a population, the means for each sample would form an approximately normal distribution. This statistic utilizes the standard deviation of the sample and the sample size to estimate how closely the sample data approximates the data that would be collected if the entire population were measured. The formula for the standard error of the mean is;

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

Where

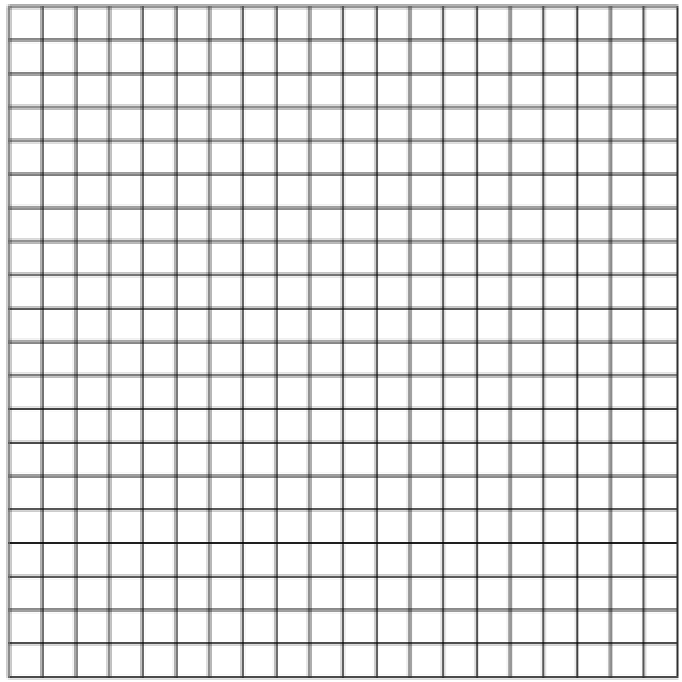
s = the standard deviation

n = total number of individuals in a sample

The standard error of the mean tells you that 68.3% of the sample means are within ±1 standard error of the entire population mean. A sample mean of ±1 SE describes the range of values about which an investigator can have ~ 67% confidence that the range includes the true population mean. Even better, a sample with ±2 SE defines a range of values with approximately **95% certainty.** The 95% confidence interval is typically used when graphing. The graph shows data means graphed with error bars for a calculated SE = 5. Bars are drawn 5 units above and below the sample means. The AP exam may have you include error bars in graphs. ***If the standard error bars for your samples overlap--there is NO significant difference!***

8) Looking at your Drosophila data, calculate the ±1 SEM and ±2 SEM (literally multiply your ±1 SEM by 2)
(4 pts)

	# Drosophila on Right	# Drosophila on Left
x		
s		
±1 SEM		
±2 SEM		



9) Plot on the graph mean ± 2 SEM. **(5 pts)**

10) Is this data significant? Why or why not? **(2 pts)**

Percent Change in Mass of Potato Cores in Various Sucrose Solutions													
Sucrose Conc. (M)	Grp 1	Grp 2	Grp 3	Grp 4	Grp 5	Grp 6	Grp 7	Grp 8	Grp 9	Grp 10	Grp 11	Grp 12	Mean
0.0	23.7	28.12	22.9	22.4	27.8	25.7	27.5	28.7	29.4	28.3	25.5	26.5	26.4
0.2	7.5	9.8	5.3	13.6	9.4	14.4	8	11.6	13.6	5.5	8.3	4.9	9.3
0.4	-8.1	-15.16	-15.4	-9.4	-7.8	-5.3	-11	-8.8	-8.9	-12.6	-15.5	-8.7	-10.6
0.6	-24	-22.6	-23.2	-20.2	-24.2	-21.1	-23.4	-21.8	-20.2	-27.3	-20	-20.6	-22.4
0.8	-34.6	-32.3	-33.4	-30.5	-29.6	-28.8	-29.9	-27.2	-30.5	-26.6	-26.4	-32.75	-30.2

We can use this data to calculate the standard deviation for each group. The standard deviation for 0 M sucrose is calculated here as an example:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(xi - \bar{x})^2}{n-1}}$$

$$s = \sqrt{\frac{\sum (-2.7)^2 + 1.72^2 + (-3.5)^2 + (-4)^2 + 1.4^2 + (-0.7)^2 + 1.1^2 + 2.3^2 + 3^2 + 1.9^2 + (-0.9)^2 + 0.1^2}{11}}$$

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

$$= \sqrt{\frac{\sum (-2.7)^2 + 1.72^2 + (-3.5)^2 + (-4)^2 + 1.4^2 + (-0.7)^2 + 1.1^2 + 2.3^2 + 3^2 + 1.9^2 + (-0.9)^2 + 0.1^2}{11}}$$

$$= \sqrt{\frac{\sum (7.29 + 2.89 + 12.25 + 16 + 1.96 + 0.49 + 1.21 + 5.29 + 9 + 3.61 + 0.81 + 0.01)}{11}}$$

$$= \sqrt{\frac{60.81}{11}}$$

$$= 2.35121$$

$$s = \sqrt{\frac{60.81}{11}} = 2.35$$

11) Calculate the standard deviation for the Sucrose data that is included in the table below. Then determine the number for ±1 SEM and ±2 SEM.

Now that you have completed your calculations, write them in the data table below, along with the data calculated by the other groups:

Concentration of Sucrose, [M]	Mean	Standard Deviation	±1 SEM	2 SEM
0.0	26.4			
0.2	9.3			
0.4	-10.6			
0.6	-22.4			
0.8	-30.2			

15 pts

12) Draw a line graph of the mean ±2 SEM for your sucrose data. Label graph and axis. **(6 pts)**

Title____

13) What information does this graph show? What do the error bars mean? Are the data significant? Why or why not? **(3 pts)**