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| Basic Experimental Design Tips | Graphs and Data  | Interpreting Data |
| **Independent Variable** – The actual thing that you are testing and changing across your experimental groups. If you are testing how concentration of acid affects the growth of a plant, then the independent variable will be the concentration of acid. **Dependent Variable** – The response to your independent variable changing. In the example above, it would be the growth of the plant (because you are measuring growth after every concentration change).**Control Group** – The group that does not contain your independent variable, or the absence of what you’re experimenting. This is to see whether or not your independent variable actually causes a difference compared to when it didn’t exist. **In a controlled experiment, you only ever have one independent variable.** In long responses, you might be asked to design an experiment or to predict an outcome. You must be able to READ carefully any time you see the words “Design” and “Predict” because you need likely need to know the above variables to get full points! If you can discern this information it makes reading the data a lot easier!  | When constructing graphs always make sure you have the following: 1. Label your axis with UNITS. You will not get the point if you don't’ have units.
2. Graph all data points that they give you.
3. Make sure that your scales are consistent (if you have a unit of 1 between every square, it must be that way for the rest of the axis.)
4. If given a data table, your first column is usually the X axis (Independent variable) and your second column is usually your Y Axis (Dependent Variable)
 | In any data table that you are asked to graph, you might see the SEM.• Make sure that you plot the SEM times 2 and depict that with brackets that are +2SEM above the mean and -2SEM below the mean.If the SEM bars are overlapping, take this to mean that two data sets have no statistical significant difference. Example below: /Users/hilariodiaz/Desktop/Screen Shot 2018-10-02 at 8.17.02 PM.pngIn august, the SEM brackets are not overlapping. In September, the SEM brackets are overlapping |
| Hypothesis  |
| **Null Hypothesis** – Hypothesis you write when saying Independent Variable does not have an effect on your dependent variable. Nothing is influencing your results. **Alternative Hypothesis** – Hypothesis you write when you say something influenced your results (your independent variable.) You disprove the null and accept the alternative.  |
| Statistical Tests/Language | Continuous vs Discrete Data | Writing Tips for Full Points on Long Response |
| **Standard Deviation** – Represents the spread of your data from the mean/average. **SEM** – Standard Error Mean – Represents how accurately your sample mean represents the population mean. (Comparing your sample to that of the world). When you graph the SEM, you always graph the SEM multiplied by 2. This represents a 95% confidence interval. There are two main Statistical Tests are used. **\*T tests are NOT on AP Bio exam**1. T tests – Used when comparing means. Must contain categorical *and* quantitative variables. NOT ON
2. Chi Square – When looking at categorical data. You’ll see this pop up a lot with the law of independent assortment.

Summary: The t-test allows you to say either "we can reject the null hypothesis of equal means at the 0.05 level" or "we have insufficient evidence to reject the null of equal means at the 0.05 level." A chi-square test allows you to say either "we can reject the null hypothesis of no relationship at the 0.05 level" or "we have insufficient evidence to reject the null at the 0.05 level." | **Continuous Data** is usually numerical, such as temperature and time. This is usually depicted in a Line Graph. Think rates. **Discrete data** is categorical and separated across different experimental groups. This is usually depicted in a bar graph.  | • Spelling does not matter, but do try your best to spell correctly. • If you contradict yourself, you have no points even if you do have it right. • If you are asked to list 3 things, and you list 5, you are only scored on the first 3. • You must absolutely write in complete sentences. Bullet points will not earn you points. • You don’t have to answer the parts (A., B., C., D.) in order. • Don’t add any background information that’s unnecessary. You can answer most bold points in one or two sentences. Keep this in mind!! • Incorrect points will not deduct points. Again, just don’t contradict yourself.• If you draw a diagram, you must explain your diagram.• 25% of your total score for the AP rides on the first two questions of the writing portion of the exam. One of them is based on Experimental Design. Review any labs we’ve done or any data sets available to get used to interpreting information.  |