NAME _____

AP BIOLOGY GRAPHING PRACTICE

Graphing plays a major role in AP biology. Most students think they know how to graph because they have graphed a lot in math classes. Past experience has indicated that this is a false sense of knowledge since oftentimes one can use a graphing calculator or plots on graph paper with axes and scaling already on the graph. In AP Biology you will almost always be given a blank graph and will have to determine the proper size, scaling and axes for the graph you will be plotting. Points are often awarded for

1. correct scaling (Proper spread of axis numbers and the use of most of the graph)
2. correct labeling of axes with units
3. correct plotting of data points
4. sometimes you may get a point if the graph is properly titled

Science Practice 4: Representing and describing data

Representing and describing data is one of six major practice skills that you will need to learn for the national exam.

You must know how to construct and interpret the following graph types:

1. X,Y 2. Bar 3. Line 4. Box & Whisker 5. Log Y 6. Histogram 7. Dual Y 8. Pie

1. Remember **TAILS** when creating a graph

- **Title:** Depicts what the graph is about. The title gives the reader an understanding about the graph. A good title is closer to a sentence than a phrase and is usually found at the top of the graph.
- **Axes:**

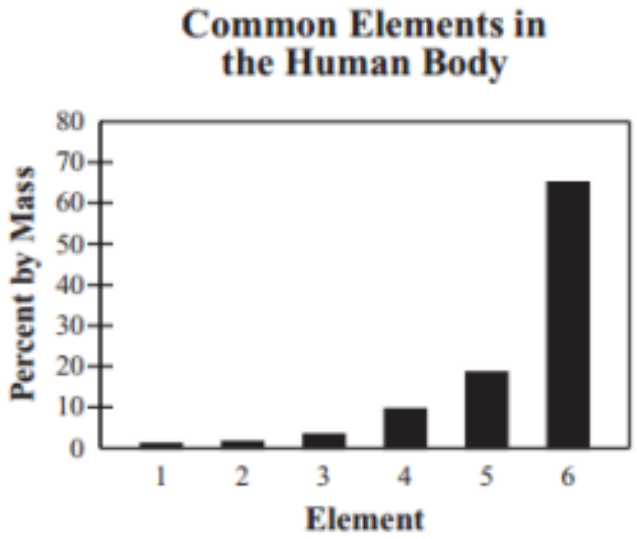
  Independent Variable**:** Variable controlled by the experimenter. The variable that "I" am testing. (I for Independent). This variable goes on the X-axis. If there are more than one independent variable you should also have a key

  Dependent Variable**:** Variable that is affected by the independent variable; what is being measured. This variable goes on the Y-axis.

- **Interval:** Each axis should have clearly marked and evenly spaced intervals.
- **Labels:** Should briefly describe the variables on the axes. Be sure to include units!
- **Scale:** Before you can plot your data points, you must figure out how much each box on your graph paper is worth. Use the range of data (max – min) to help you determine a scale that makes sense. Scale doesn't always have to start at zero, but it must be consistent. If you start off making each box worth 5 cm, each subsequent box must also be 5 cm.

Example:

Using the information above, identify what is good about the graph below and what needs improvement



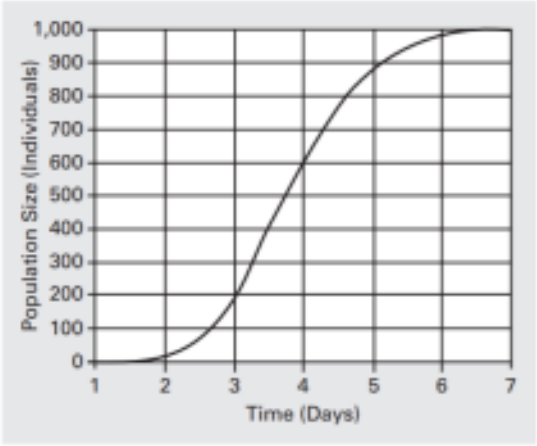
Good:

Improve:

Let's learn about each graph type and then practice constructing some of them.

1. **<u>X, Y Graph</u>**:

   This is your standard graph with the independent variable on the X-axis and the dependent variable on the Y=axis. An example is at right.



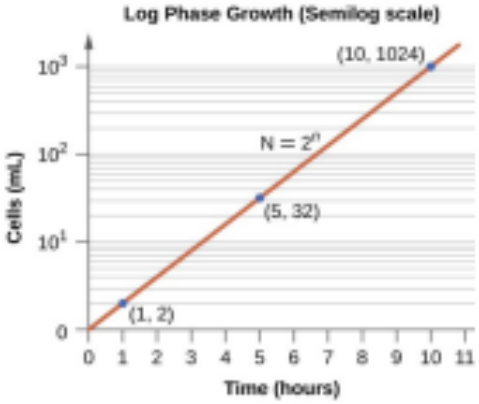
Example:

Sometimes rates can be determined from graphs by determining the slope ($\Delta Y/\Delta X$). Study the X,Y graph above and determine the change in population per day (include units!)

A. between days 3 and 4. _____ B. between days 3 and 5. _____

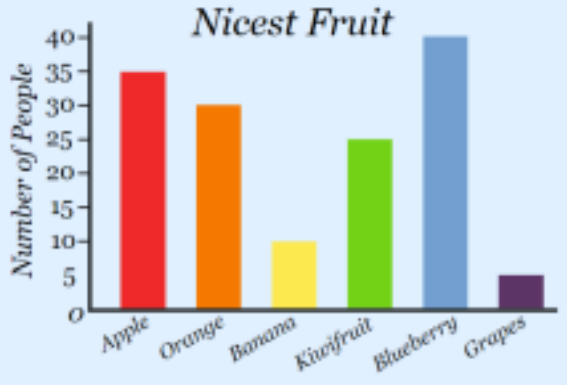
2. **Log Y graph**:

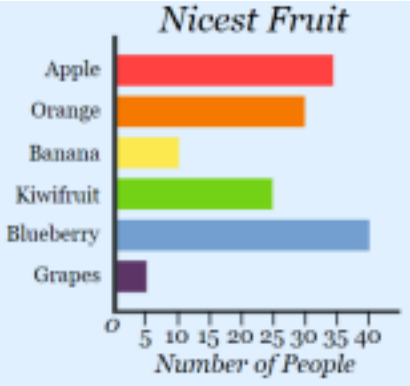
This graph is similar to the X,Y graph except the Y axis is a logarithmic scale. Note line spacings: separation decreases as one goes up the Y axis



3. **Bar Graph**:

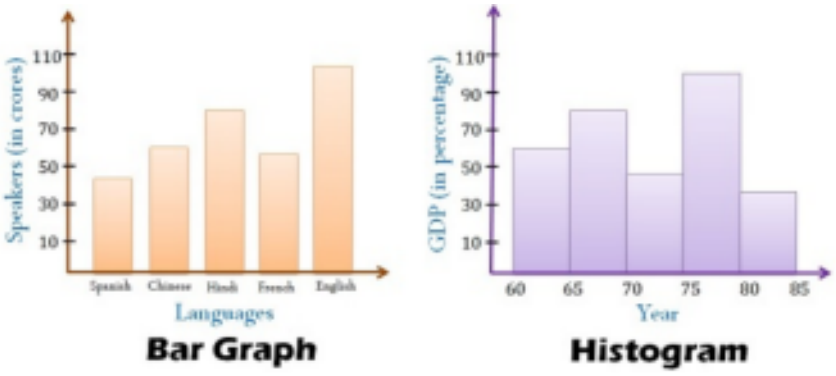
A graph showing the numerical value of a variable as the height or length of a rectangle representing categorical (non numerical) data. Note that the categorical data can be on the horizontal or vertical axis





4. **Histogram**:

A histogram is like a bar graph except that the data is noncategorical and continuous (think distribution) and that the rectangles are placed side-by-side. A **histogram** represents the frequency distribution of continuous variables. Conversely, a **bar graph** is a diagrammatic comparison of discrete variables. A **histogram** presents numerical data whereas a **bar graph** shows categorical data. The **histogram** is drawn in such a way that there is no gap between the **bars**.



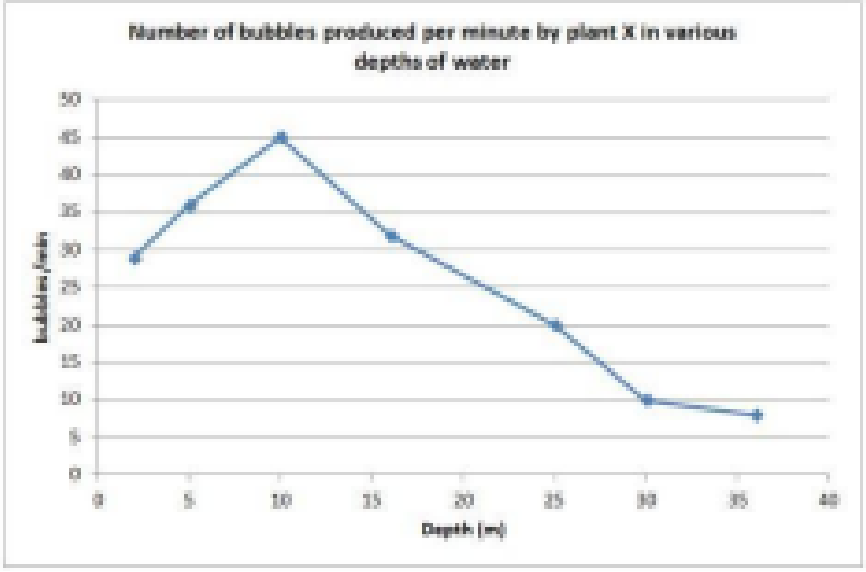
5. **Line Graph**:

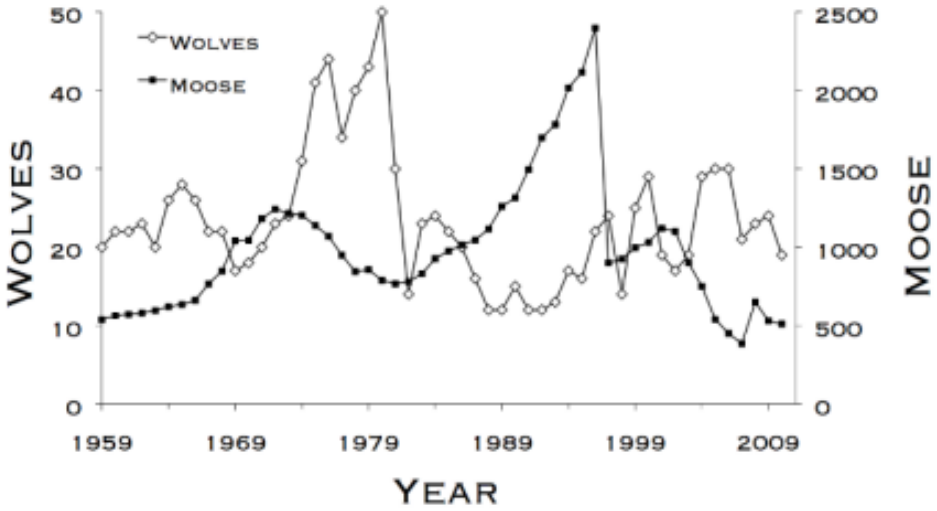
A **line graph** consists of a series of points plotted on the grid and connected point to point by a **line**. **Line graphs** are only used when both variables are quantitative. **Line graphs** show trends, such as

how things change over time. See the example below. Lines should start and end on dots! **Do not draw the line past a dot unless asked to extrapolate**

6. **Dual Y Graph**:

A graph showing two dependent variables (Y-axes) for the same independent variable (x-axis). The Y-axes are placed at opposite ends of the X-axis and scaled and labeled independently.





A. In which year is the moose population the greatest? _____

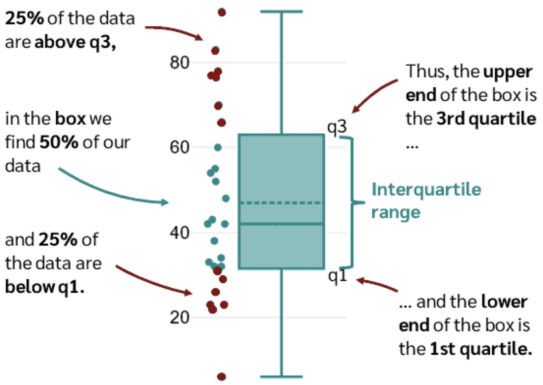
B. What is the moose population in that year? _____

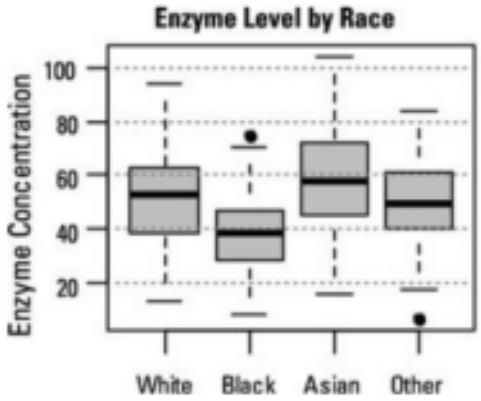
C. In which year is the wolf population the greatest? _____

D. What is the wolf population in that year? _____

7. **Box and Whisker Graph**:

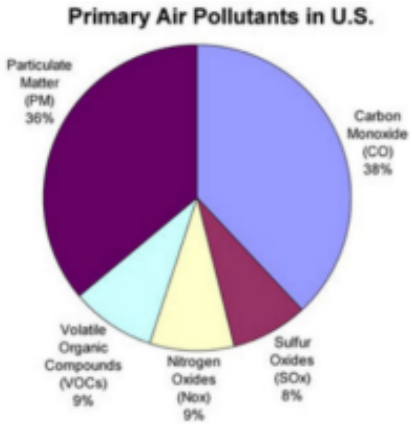
A graphic way to display the median, quartiles, and extremes of a data set on a number line to show the distribution of the data.





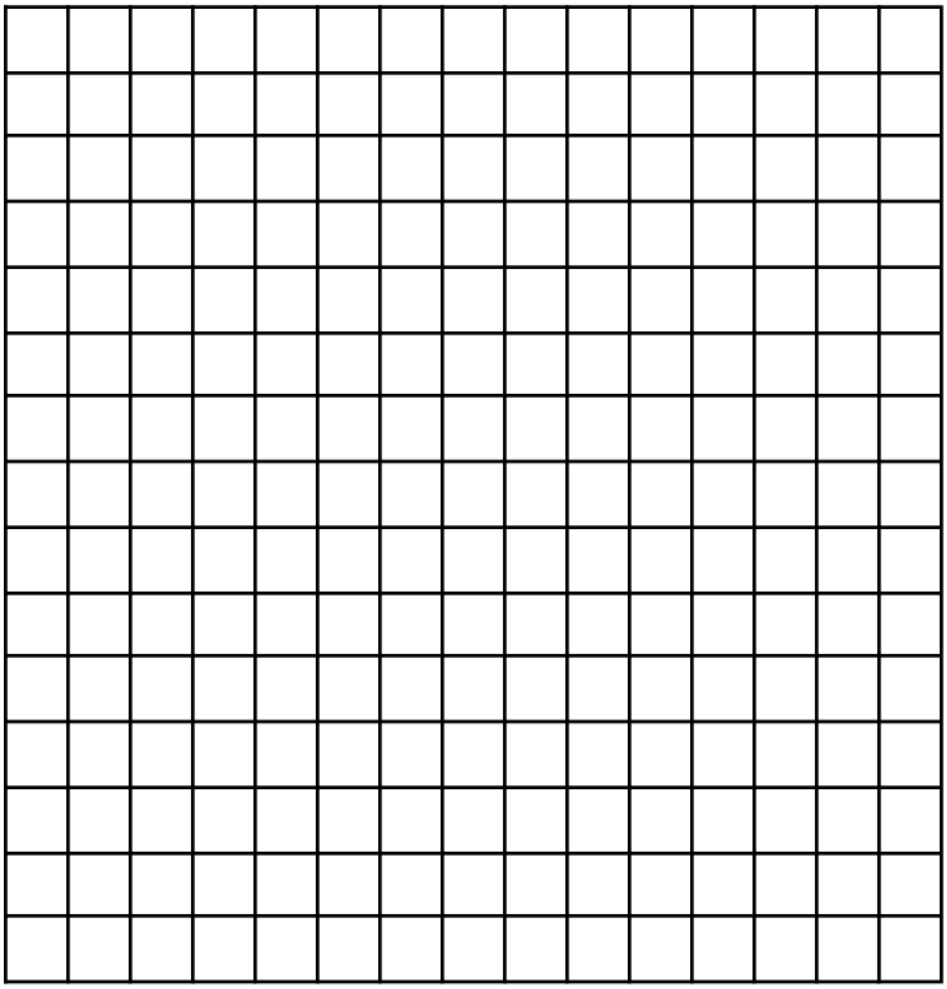
8. **Pie Graph**:

A special **chart** that uses "**pie** slices" to show relative sizes of data. The **chart** is divided into sectors, where each sector shows the relative size of each value. The total equals 100%.



It is Practice Time! Correctly construct graphs and interpret data asked below.

Title:



I. Following a flu outbreak, a student gathered data on the number of students who became ill until she became sick on the 14th day of her study. The information she gathered is shown below. Create a line graph of the data below on the graph above. Be sure to scale the graph properly and label the axes.

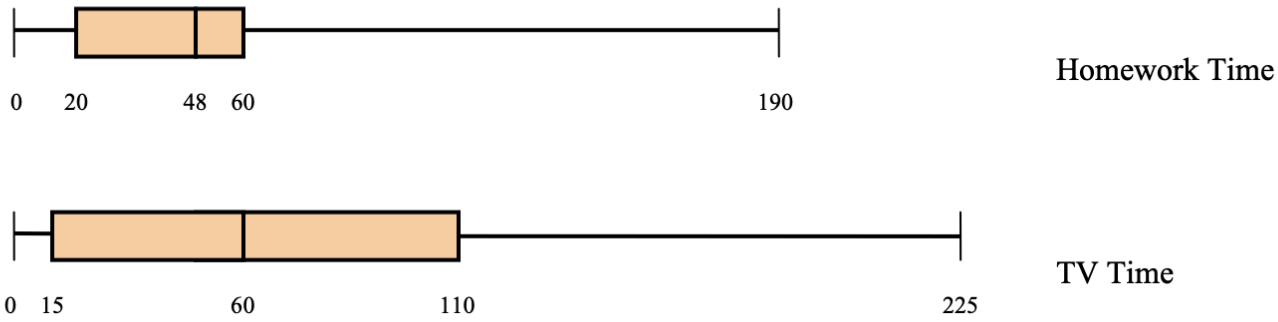
Date (Feb., 1996)	Number of ill Students
1	12
2	18
3	30
4	49
5	115
6	127
7	125
8	107
9	108
10	115
11	117
12	95
13	60
14	52

1. Between which two days was the rate of reported illnesses the greatest? _____

2. Estimate the probable number of students who might report to be ill on day 15 if the trend continues. _____

II. Refer to the box & whisker graphs below that compare homework time per night with TV time per night for the same group of sophomores.

TV & Homework Minutes per Night



1. What percent of the sophomores spend less than 20 minutes per night on homework? _____

2. What is the most number of minutes a sophomore spends watching TV per night? _____

3. What is the range of times that the middle 50% of sophomores spend on homework per night? _____

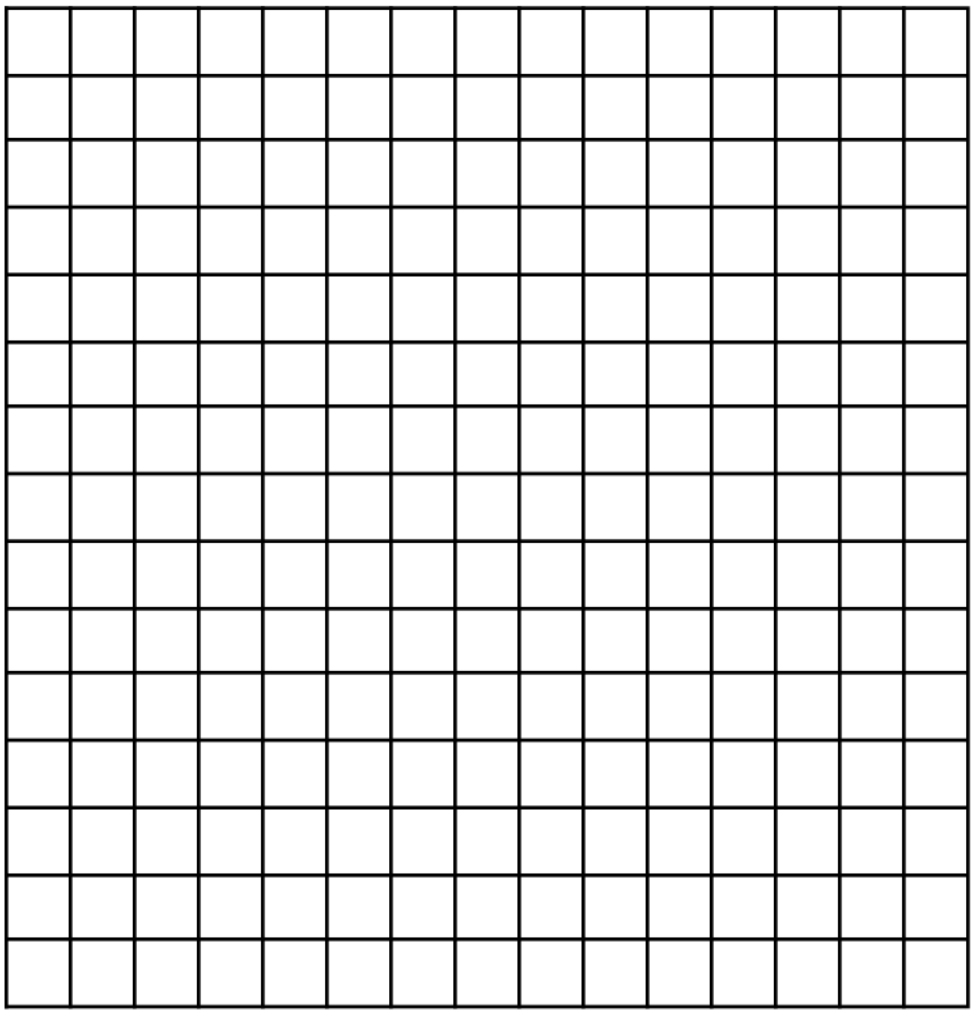
4. What percent of the sophomores watch TV for at least 110 minutes per night? _____

5. Is it more common for a sophomore at this high school to spend more than 1 hour on homework or more than 1 hour watching TV? Explain using data.

III. Many types of cancer are related to genetic mutations, including a mutation of the BRCA1 gene that has been linked to breast cancer and ovarian cancer in women. The data in the table below shows the incidence of different types of cancers in males and females in the United States during 2002. Each of the values in the table represents the frequency of a particular type of cancer per 100,000 people. Use the data to construct a histogram that shows the frequency of different types of cancers in males and females.

Cancer Type	Males	Females
Bladder	37.0	9.4
Colon	61.3	44.9
Lymphoma (non-Hodgkin)	22.0	15.5
Lung	86.4	53.7
Melanoma	20.9	13.6
Pancreas	12.3	9.5

Title:



WATCH THESE TWO VIDEOS ON STANDARD DEVIATION AND STANDARD ERROR.

IF THIS IS A PRINTED VERSION OF THE WORKSHEET GOOGLE BOZEMAN SCIENCE STANDARD DEVIATION AND BOZEMAN SCIENCE STANDARD ERROR.

IV: Using standard errors (S.E.) on a bar graph can help one visualize if there is a significant difference between two groups. If the error bars overlap, there is likely no difference and if there is no overlap, then there is likely a difference. Note that this does not work with standard deviation, only standard error. Study the graph below and answer the accompanying questions assuming the bars represent one standard error of measurement.

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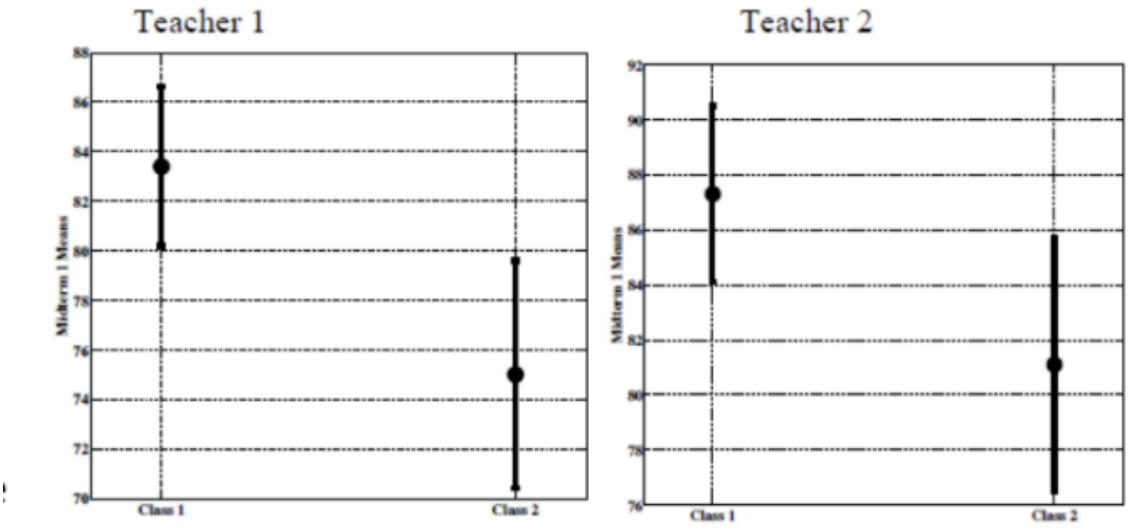
Two different AP biology teachers compute the mean and standard deviation for their 2 AP biology classes.



1. Are the differences between Class 1 and Class 2 statistically significant for Teacher 1? Explain your answer.

2. Repeat with teacher 2.

V**:** You are studying the effect of a plant growth hormone, auxin, on the growth rate of a particular plant species. You decide to measure the growth rate (in cm per week) of plants treated with auxin compared to a control group that receives no treatment. Each group has 4 plants, and the experiment is conducted over four weeks. The growth rates for each plant are recorded below.

Data:

- **Control Group (0 ppm):**
  - Plant 1: 2.4 cm/week
  - Plant 2: 2.7 cm/week
  - Plant 3: 2.2 cm/week

- Plant 4: 2.8 cm/week

- **Treated Group (50 ppm Auxin):**
  - Plant 1: 4.2 cm/week
  - Plant 2: 4.5 cm/week
  - Plant 3: 3.9 cm/week
  - Plant 4: 4.8 cm/week

SHOW WORK BELOW!

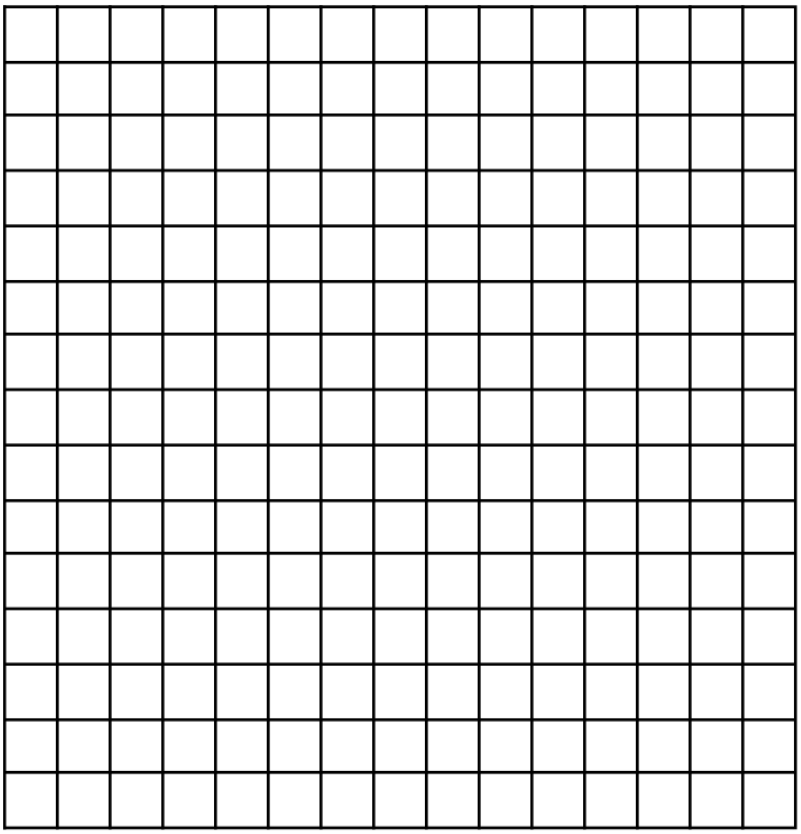
1. Calculate the mean for each group.

2. Calculate the standard deviation for each group using this online calculator. YOU WILL NEVER HAVE TO CALCULATE IT BY HAND IN AP BIO

3. Calculate the standard error in the growth rate of the plants using this online calculator. YOU WILL NEVER HAVE TO CALCULATE IT BY HAND IN AP BIO

4. Make a bar graph of the means. Draw the error bars on the graph that represents +/- 2 SEM. In biology they typically ask you to graph +/- 2 standard errors of the mean. Graphing +/- 2 SEM, creates a 95% confidence interval meaning that there is a 95% chance that the true population mean falls within that range.

Title:



5. Identify if there is a statistically significant difference in growth rate between the control and treated groups. Justify your conclusion.