Welcome to AP Biology

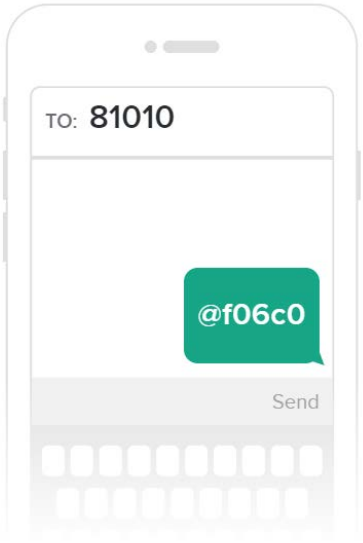
This course is designed to offer students a solid foundation in introductory college-level biology. The process of inquiry in science and developing critical thinking skills is the most important part of this laboratory intensive course. Throughout the year students will develop an appreciation for the study of life and understand the unifying principles within a diversified biological world which includes the following:

1. The process of evolution drives the diversity and unity of life.
2. Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
3. Living systems store, retrieve, transmit and respond to information essential to life processes.
4. Biological systems interact, and these systems and their interactions possess complex properties.

I've prepared a summer assignment to give students a quick review of some basic scientific skills. AP coursework is rigorous and requires students to go above and beyond the expectations of regular biology classroom. This summer work will ensure that students have the skills needed to be successful in the first weeks of class. Students can complete the summer work on their own, or they can complete the summer work during the **West AP Science Skills Camp on June 11th through June 14th from 8:00 am to 12:00 pm.**

The camp will be very interactive, allowing students opportunities to design experiments and carry out these investigations. This year students will use spectrophotometry to explore factors that influence the growth of *E. coli* and determine the bacteria's biotic potential and carrying capacity. Students will also investigate antigen and antibody interactions and develop an ELISA assay of to track production of a ovulation hormone in giant pandas. Tracking hormones like estrogen and luteinizing hormone is important to predict the onset of ovulation. These practical applications give students a real-world experience that will allow them to apply the quantitative skills of graphing, data analysis, hypothesis testing and mathematical modeling that they will use throughout the year. There is no fee associated with the camp and students who wish to attend should contact me if they have not already registered.

I am available during the summer if students need assistance. While I will check my voicemails periodically through the summer, I am always available by email at jbaxter@jths.org or by text using Remind. Students can sign up for Remind by texting @f06c0 to 81010. Contact information is completely private. All messages are sent through Remind numbers and emails, not your personal phone number or email address. Messages on Remind can't be edited or deleted, so there's a permanent record of every conversation. Every user can download and email their message history at any time.



If you have any questions, please feel free to contact me. I look forward to a fun and educational year.

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AP BIOLOGY SUMMER ASSIGNMENT 2018-2019

Objective 1: Identify components of strong experimental design

Background Information on Experimental Design

What's a "fair test": http://undsci.berkeley.edu/article/0_0_0/fair_tests_01

Developing a "fair test"

http://undsci.berkeley.edu/article/0_0_0/fair_tests_02
http://undsci.berkeley.edu/article/0_0_0/fair_tests_03
http://undsci.berkeley.edu/article/0_0_0/fair_tests_04

Below is an experiment that was designed to investigate the effect of sulfur dioxide on soybean reproduction. Answer the following question on the effective components of this experimental design.

Agricultural scientists were concerned about the effect of air pollution, sulfur dioxide in particular, on soybean production in fields adjacent to coal-power plants. Based on initial investigations, they proposed that sulfur dioxide in high concentrations would reduce reproduction in soybeans. They designed an experiment to test this hypothesis. In this experiment, 48 soybean plants, just beginning to produce flowers, were divided into two groups, treatment and no treatment. The 24 treated plants were divided into four groups of 6. One group of 6 treated plants was placed in a fumigation chamber and exposed to 0.6ppm (parts per million) of sulfur dioxide for 4 hours to simulate sulfur dioxide emissions from a power plant. The experiment was repeated on the remaining three treated groups. The no-treatment plants were divided similarly into four groups of 6. Each group in turn was placed in a second fumigation chamber and exposed to filtered air for 4 hours. Following the experiment, all plants were returned to the greenhouse. When the beans matured, the number of bean pods, the number of seeds per pod, and the weight of the pods were determined for each plant.

1. An independent variable is changed or manipulated by the scientist. **Identify** the independent variable?

2. A dependent variable is measured or observed. **Identify** the dependent variable(s)?

3. Controlled or constant variable are the same in all groups. **Identify** as many controls as you can.

4. **Explain** why replication and sample size are important considerations when designing an experiment. **Describe** how these scientists incorporate replication and sample size in their investigation.

5. **Identify** the treatment was given to the control group?

6. **Identify** the level of treatment given to the experimental group? (*This is a concentration and/or time.)*

7. **Describe** result(s) that would support the scientists' hypothesis.

8. **Describe** result(s) that would force the scientists to reject the hypothesis?

Objective 2: Create an experiment to investigate a scientific question

The active ingredients in many pesticides are chemical compounds that kills organisms such as insects, molds, and weeds. Opponents of pesticides use claim that pesticides degrade water and soil quality. Design a laboratory experiment to determine whether or not a new pesticide (product X) is toxic to minnows, a type of small fish.

9. **Create** a hypothesis for this scenario. (Do not use if…then statements. Include a prediction of result and propose a scientific explanation for these results. Multiple sentences are often needed.)

10. **Describe** the method you would use to test your hypothesis.

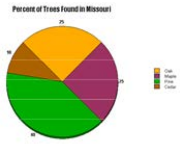
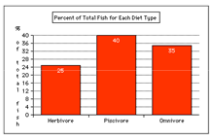
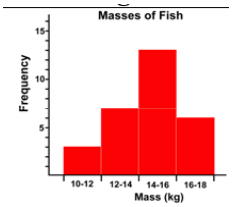
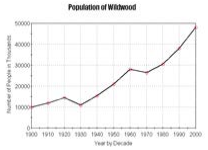
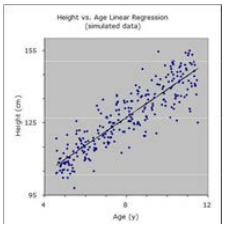
11. **Identify** the control.

12. **Identify** the dependent variable(s).

13. **Describe** experimental results that would lead you to reject your hypothesis. (Be specific)

Objective 3a: Create Effective Visuals; Choosing an appropriate graph

There are several types of graphs that scientists often use to display data. They include:

Pie Graphs	Bar Graphs	Histograms	Line Graphs	Scatter Plots
				
- Dependent variable is NOT continuous. -Usually presents data as a "part of a whole" or as percentages.	-Dependent variable is NOT continuous. -There is no order to the categories on the X-axis. -Bars typically don't touch. -Y-axis is usually a percentage or frequency (count)	-A specific type of bar graph. -Dependent variable must have a natural order that can be grouped into defined "chunks".	-Dependent variable IS continuous. -Points are plotted <u>using</u> x and y components. -The points are connected because the observations are NOT independent.	-Dependent variable IS continuous. -Points are plotted using x and y components. -The points are NOT connected because the observations are independent. -Uses a best-fit line or curve to show relationship.

Identify the best type of graph to represent each type of data set.

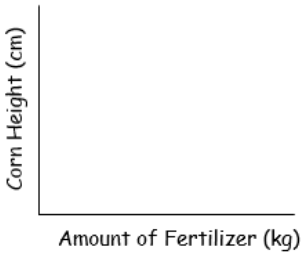
#	Description	Pie	Bar	Histo	Line	Scatter
Ex	A graph showing the number of 5th graders who prefer Coke or Pepsi		X			
14	a newborn baby's weight changes over time					
15	percentage of the class earning As, Bs, and Cs.					
16	distribution of trees of different size groups (e.g. 0-10 cm, 10-20 cm, etc.…) in a forest					
17	relationship between height and arm length in a group					
18	percentage of an allowance spent on different categories (e.g. food, movies, etc.)					
19	amount of rainfall, by month over a 12-month period					
20	number of ice cream cones purchased as a function of the day's temperature					

Objective 3b: Create Effective Visuals; Labeling Axes

When labeling your axes, keep 3 things in mind:

- The independent (manipulated) variable is written along the horizontal axis (X axis)
- Dependent (responding) variable is written along the vertical axis (Y axis)
- Units on any variables should be included in parentheses ( ) following the axis title

SAMPLE: A farmer wants to know if there is a relationship between the amount of fertilizer (in kilograms) she uses and how tall her corn grows (in centimeters).



For each experiment described below, write the independent and dependent variable on the appropriate axis. Be sure to include units when appropriate.

22. Geologists wanted to know if there was a relationship between the density (in g/cm^3) of a rock and how many meters down it was collected from.	**23.** A scientist studied the relationship between amount of rain (in cm) and the numbers of zebra babies born each spring.
24. Sea otters were counted over several years to see if their numbers were decreasing over time.	**25.** Does the amount of nitrogen in the soil (measured in kilograms) affect corn production (measured in kilograms).

Objective 3c: Create Effective Visuals, Scaling Axes

There are a few important steps involved in correctly scaling an axis:

STEP 1: Find the range for the variable Range = Largest Value - Smallest Value

STEP 2: Divide the range by the number of intervals you want (not too many or too few). We don't want all of the data smooshed in only part of the graph; spread it out. After dividing, we may need to round *up* to get a number that is easy to count by. (It is easier to count by 2s instead of 1.9s)

STEP 3: Use the rounded number to mark off intervals along the axis.The interval must be the same amount each time (count up by the same number).

26-28. Determine range

EX.

Mass (g)
5
11
14
19
26
30
40

Largest #: 40

Smallest #: 5

Range: 40-5 = 35

A)

Students
100
99
88
70
72
64
55

Largest #: _____

Smallest #: _____

Range: _____

B)

Distance (cm)
3
5
6
7
9
10
12

Largest #: _____

Smallest #: _____

Range: _____

C)

Time (s)
0.22
0.51
0.78
1.01
1.23
1.60
1.74

Largest #: _____

Smallest #: _____

Range: _____

29-31: Determine the interval values. Your graph has 10 intervals (places to put numbers).

A)

Range = 35

# of intervals = 10

$\frac{\text{Range}}{\text{Intervals}} = \frac{35}{10} = 3.5$

Round to Count = 4

A)

Range = _____

# of intervals = _____

B)

Range = _____

# of intervals = _____

C)

Range = _____

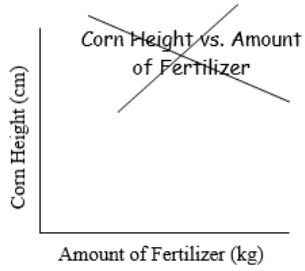
# of intervals = _____

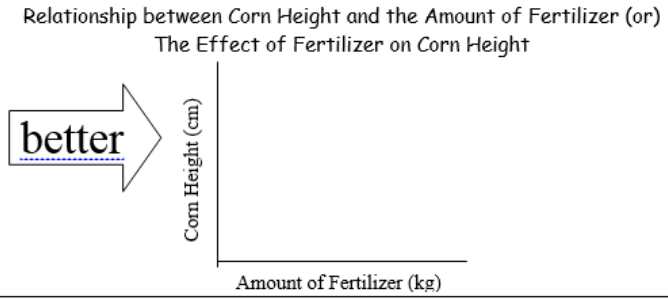
Objective 3d: Create Effective Visuals, Forming Proper Titles

When writing a title for you graph, please remember

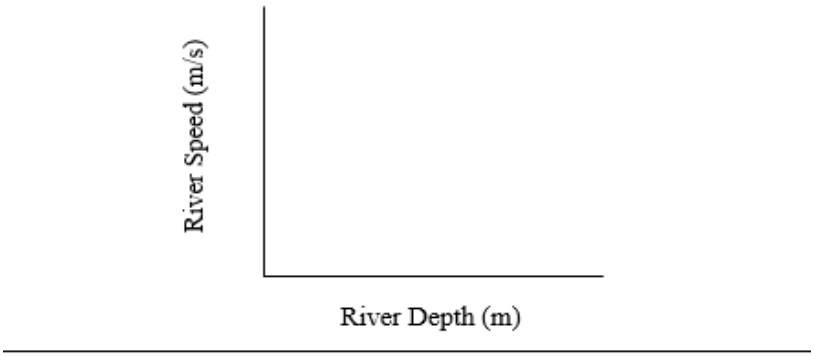
- The title must communicate the dependent and independent variables
- The title cannot be presented in the form "Y versus X"
- Some graphs need more explanation than others. Make sure your reader would be able to understand what your data represent.

SAMPLE: A farmer wants to know if there is a relationship between the amount of fertilizer (in kilograms) she uses and how tall her corn grows (in centimeters).





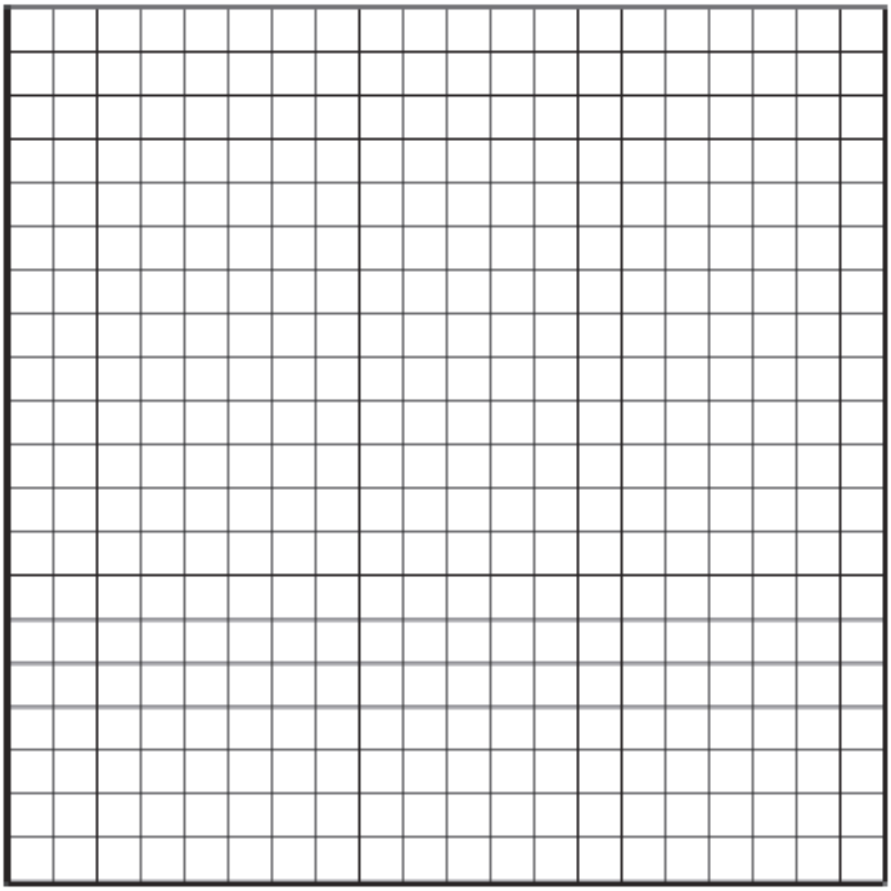
32. Create a title for the following graph.



33. Putting it all together. Graph the following data set and include appropriate scale, title, and axis labels.

Plants lose water from their aboveground surfaces in the process of transpiration. Most of this water is lost from stomata, microscopic openings in the leaves. Excess water loss can have a negative effect on the growth, development, and reproduction of a plant. Severe water loss can be fatal. Environmental factors have a major impact on the rate of plant transpiration.

Temperature (°C)	20	23	27	28
Transpiration Rate ($mmol/m^2.sec$)	1.5	3	5	4.5



Objective 4a: Understand the Mechanism of Natural Selection, Dispelling Misconceptions

Click through the Recipe for Evolution: http://learn.genetics.utah.edu/content/selection/recipe/
Click through Things You May Not Know About Evolution
http://learn.genetics.utah.edu/content/selection/misconceptions/

All of the following statements are **FALSE**. Explain why.

34. Evolution is a theory about the origin of life.

35. Evolution is like a climb up a ladder of progress; organisms are always getting better.

36. Natural selection happens randomly or "by chance".

37. Natural selection involves individual organisms trying to adapt to a changing environment.

38. Natural selection creates perfect organisms.

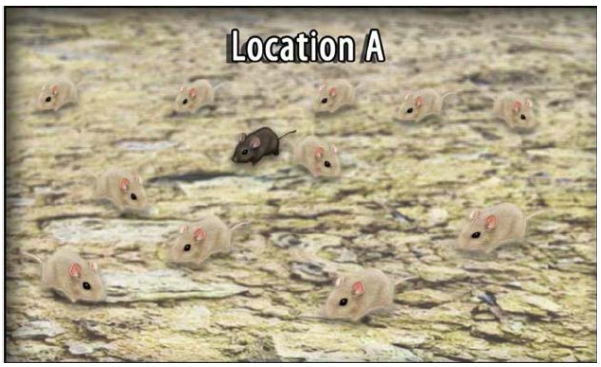
39. Evolution is "just" a theory. If enough evidence is gathered it could become a law.

Objective 4b: Understand the Mechanism of Natural Selection, Evidence of Evolution

Instructions:

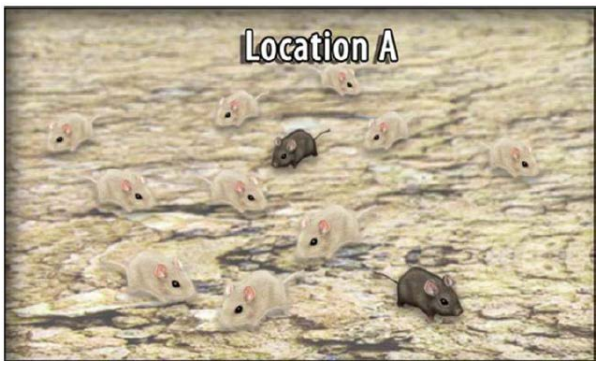
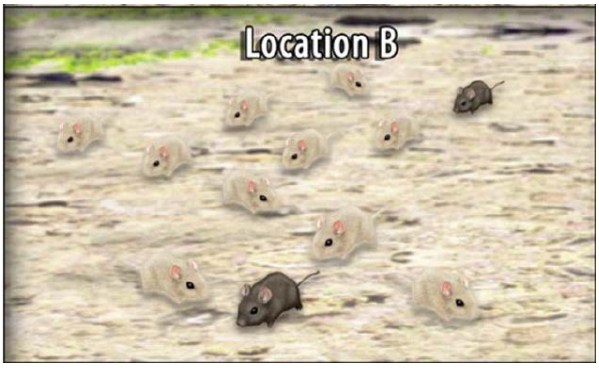
1. Watch this short 10 minute video from the Howard Hughes Medical Institute, The Making of Fittest, Natural Selection, and Adaptation http://www.hhmi.org/biointeractive/making-fittest-natural-selection-and-adaptation
2. Count the number of light-colored and dark-colored mice present at each location at each moment in time. Record your counts in the spaces provided at the top of each illustration.
3. Place illustrations W, X, Y and Z. In what YOU think is the correct order from oldest (1st) to the most recent (4th).

ILLUSTRATION W

Location A Light fur: _____ Dark fur: _____	**Location B** Light fur: _____ Dark fur: _____
	

When all four illustrations are placed in order, this one is: *First (oldest); second; third; fourth*

ILLUSTRATION X

Location A Light fur: _____ Dark fur: _____	**Location B** Light fur: _____ Dark fur: _____
	

When all four illustrations are placed in order, this one is: *First (oldest); second; third; fourth*

ILLUSTRATION Y

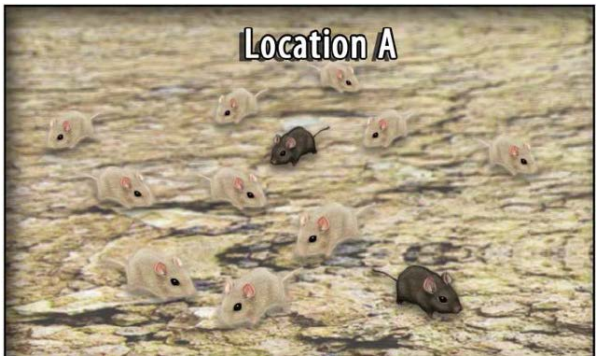
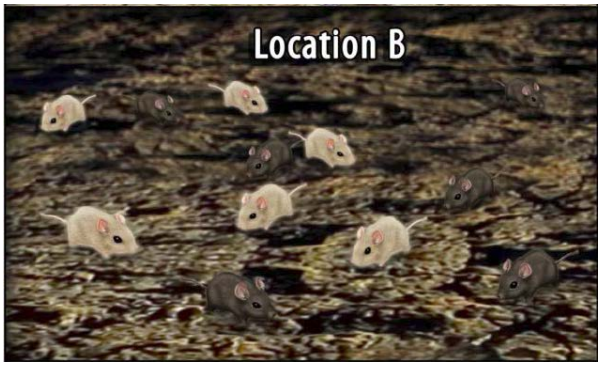
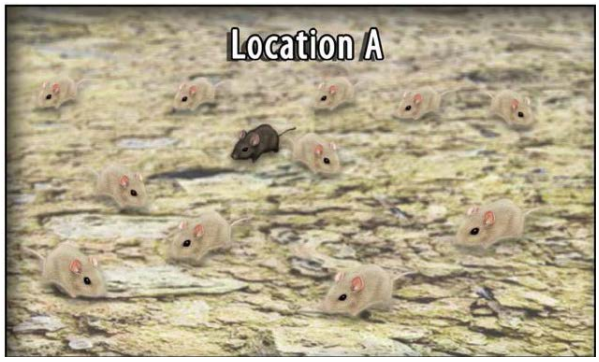
Location A Light fur: _____ Dark fur: _____	**Location B** Light fur: _____ Dark fur: _____
	
When all four illustrations are placed in order, this one is: *First (oldest); second; third; fourth*	

ILLUSTRATION Z

Location A Light fur: _____ Dark fur: _____	**Location B** Light fur: _____ Dark fur: _____
	
When all four illustrations are placed in order, this one is: *First (oldest); second; third; fourth*	

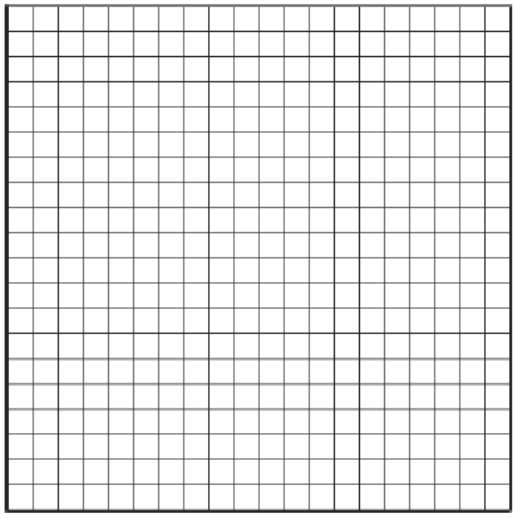
40. **Explain** how you decided which illustration represents the most recent rock pocket mouse population and why you positioned the others in the sequence as you did.

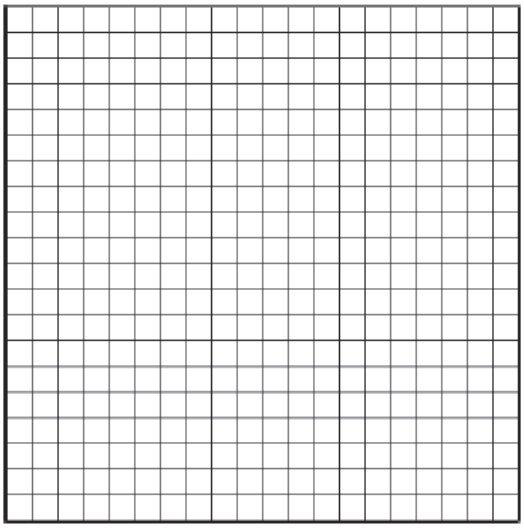
41. Fill out the data table below using the counts you recorded from the above illustration.

Table 1: Number of Mice at Different Locations

		SEQUENCE			
		Oldest (First)	**Second Oldest**	**Third Oldest**	**Most Recent (fourth)**
Location A	Number of Mice with Light Fur				
	Number of Mice with Dark Fur				
Location B	Number of Mice with Light Fur				
	Number of Mice with Dark Fur				

42. Create two graphs based on the data that shows the distribution of mice at locations A and B through time. ***Include the results for location A on the first graph. The second graph should include the data from location B.***





Objective 5: Use Statistics to Analyze Data Sets
Bozeman Video Standard Deviation https://youtu.be/09kiX3p5Vek
Bozeman Video Standard Error of the Mean https://youtu.be/BwYj69LAQOI

Seeds of many weed species germinate best in recently disturbed soil that lacks a light-blocking canopy of vegetation. Students in a biology class hypothesized that weed seeds germinate best when exposed to light. To test this hypothesis, the students placed a seed from crofton weed , *Ageratina adenophora*, in each of 20 petri dishes and covered the seeds with distilled water. They placed half the petri dishes in light and half in the dark. After one week, the students measured the lengths of the crofton weed seedlings in each dish. The table below shows their data.

43. Complete the table to calculate the standard deviation and standard error for the seeds exposed to light and the seeds left in darkness.

Table 2: Crofton Weed Seedlings Length after One Week in the Dark and the Light

Petri Dishes	**Dark (x_1) (mm)**	**Light (x_2) (mm)**	**$\overline{\text{Dark } (x_i - \bar{x}_1)^2}$ (mm^2)**	**$\overline{\text{Light } (x_i - \bar{x}_2)^2}$ (mm^2)**
1 and 2	12	18	$(12 - 9.6)^2 = 5.8$	$(18 - 18.4)^2 = 0.16$
3 and 4	8	22		
5 and 6	15	17		
7 and 8	13	23		
9 and 10	6	16		
11 and 12	4	18		
13 and 14	13	22		
15 and 16	14	12		
17 and 18	5	19		
19 and 20	6	17		
Mean ($\bar{x}$)	**9.6**	**18.4**		
Standard Deviation, $s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{(n-1)}}$				
Standard Error of the Mean, $SE_{\bar{x}} = \frac{s}{\sqrt{n}}$				

44. Create a bar graph of the mean length of crofton seedlings exposed to dark and light. Include error bars that show the standard error of the mean for each data set.