Name: _____ Period: _____

VARIATION WITHIN A POPULATION

OVERVIEW

Evolution is a tough concept to understand. You probably realize that in every population there is variation. Nature acts upon variations. Certain types of individuals are selected for; other individuals must either migrate or die. This lab will show you that there is a variety of individuals in a population.

PERFORMING THE INVESTIGATION (check off each box after completing that step)

□1. Pair off with another student, as directed by your teacher.

□2. Make sure you have the following materials: a bag with at least 50 kidney beans, a ruler and a sheet of graph paper.

□3. Now that you have your materials, describe what is in your bag (be creative and explicit). At this point, do NOT open the bag.

□4. In which ways are individuals beans from your bag different from one another. Think of ways of separating the beans into groups.

□5. Select two of the patterns or characteristics you described in part #4 (above) and physically separate the beans into two groups.

□6. Now that you separated the beans into two groups (e.g. dark vs. light, long vs. short, smooth vs. rough, etc., are there overlapping characteristics. Why would this matter?

□7. Carefully measure the length of each bean to the nearest millimeter (see picture/video). After measuring a bean, set it aside. Record your data for each bean in **Table 1** below.

□8. Using your data from **Table 1**, count and record the total number of beans of each length in **Table 2**. The "size-in millimeters" column should list, in consecutive order, all numbers within the range of bean sizes. If there is a number within this range with no beans, list the number, and record the number of beans as “0".

□9. Construct a graph using the data in **table 2**. Be prepared to share and interpret your graph with the class.

Record your data for the length of each bean in Table 1, below:

Table 1. Bean size in millimeters (columns in gray are optional)*

*The gray columns are used to calculate standard deviation “SD” (which is a measurement of how spread out the numbers are in the sample and it is NOT required to complete this exercise). If you decide to calculate SD you will need to get all your data first so you can calculate the mean (average). Once you have the mean (symbol $\bar{x}$), you will subtract each value from $\bar{x}$. In the last column, you will square this value. You will then add all those squared values and divide them by the number of values minus 1. Finally, you will take the square root of that number to get the standard deviation.

Bean #	Length (mm)	$(x_i - \bar{x})$ (mm)	$(x_i - \bar{x})^2$ (mm)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
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41.			
42.			
43.			
44.			
45.			
46.			
47.			
48.			
49.			
50.			
	Mean =		$\sum (x_i - \overline{x})^2 =$
		Variance (s^2)	$\frac{\sum (x_i - \overline{x})^2}{n-1} =$
		Standard Dev (s)	$\sqrt{s^2} =$

DATA QUESTIONS (to help you with making and presenting your graph):

1.Which size category had the most number of beans?_____

2. Which size category had the least number of beans?_____

3. What is the mean (average) length of the beans? _____

Table 2. Bean size summary (SUMMARY/POPULATION TOTALS)

Size Category in millimeters (begin with the smallest bean category)	Total number of beans (use tally marks)
Example 9 mm	*|| (if 2 beans measured 9 mm)*

Once you have placed all the tally marks, turn your paper sideways. What shape does your data make?

ANALYSIS QUESTIONS

1. How could the size of each bean reflect the interaction between the environment and the genetics of the bean?

2. Why even under ideal environmental conditions can the beans not change their size?

3. An example of "natural selection" may be a drought when smaller beans die faster than larger beans (which have greater water reserves). What effect would this selection have on the next generation (population) of beans?

4. If a group of early humans (hunter/gatherers that did not cultivate beans) preferred smaller beans over larger beans, what would happen to the future population of beans?

5. In modern agricultural societies, we cultivate plants that offer us desired characteristics. This process of "artificial selection" is often seen in mono-cultured crops. What is the long term effect of selecting for specific traits?

6. The process of choosing certain characteristics is called selection. Selection can be "natural" (naturally occurring processes) or "artificial" (caused directly by human intervention). Using the beans in question 3 or 4, explain why the bean population would change in size after 10 years. *(HINT: would the large beans be able to reproduce after they are eaten?) How would the graph compare to the original graph you made?

7. What does the standard deviation tell you about your data? (optional)