Variation within a population - TEACHER GUIDE

This lesson is an introductory, hands-on, minds-on, lesson about biological evolution. It was designed to include the three-dimensions of the Framework for K-12 Science Education to align with the Next Generation Science Standards. In this lesson students will be engaged in several of the science and engineering practices (SEPs) and their thinking guided by questions and prompts using the crosscutting concepts (CCCs). This lesson was not designed to be a "cookbook" lesson but, instead, providing opportunities to figure out the concept of variation by unpacking the phenomenon and exploring through the CCCs And SEPs.

This lesson is not necessarily tied to a particular sequence in the curriculum; it is flexible enough that it can be used in a variety of contexts. Based on the student experiences, you can subsequently cover many of the traditional concepts in evolution. For example, after this lesson you may select to address Darwin and the historical aspects of the theory of natural selection. Or, you may decide to present material on selective pressures on evolution. You may also review and apply the vocabulary covered in this lesson (words like natural selection, artificial selection, evolution, gene pool, phenotype, genotype, etc.)

During the five activities in this lesson students will be completing five activities:

1. Using patterns to identify different physical attributes that are measurable and that vary over the population. During this activity some teacher prompts include:

Do you notice any patterns when observing the beans?

What could have caused these patterns?

What span of time would be required for these changes to occur?

How would the various shapes and sizes affect the survival of the population?

2. Measuring the length of fifty beans to the nearest millimeter, in order to see variation within the patterns. Here students will be recording their data on table 1 on the guide-sheet.

3. Graphing and analyzing data of the beans grouped by length. During this activity some teacher prompts include:

What patterns do you see?

What do the patterns found in your graph say about your population?

How does the distribution by size compare to other group's graphs?

Look at your answers to the questions on your guide sheet:

How did the quantities of beans differ among the size categories?

4. Exploring patterns of variation as possible important causes for the survival of species. During this activity some teacher prompts include:

What would be some of the causes of observed patterns within a species?

How could a certain characteristic cause an organism an increased chance of survival?

Describe some typical phenotypic variations. How would these variations within a population help individual organisms to survive? What variations might disadvantage the organism for survival.

What other traits could help individuals survive?

5. Evaluating evidence about the causes and effects of variation. For this last activity, cut out the questions into strips of paper which can be handed out to each student. The six (or seven, if you are including the advance math option) questions to be answered are listed in the guide-sheet

This lesson already includes a modification for students with strong mathematical backgrounds or who would like additional challenges (but this will require more time). By including the calculations for standard deviation, many additional ideas can be explored including standard "normal" curves, population trends, data symmetry, measurements of central tendencies (mean, mode, median), variance, etc.

A very important note pertaining to the teacher prompts and questions provided in this lesson. You will notice that the prompts written into this lesson have the language of the CCC's embedded within the prompt. This is intentional and critically important in making this lesson truly three-dimensional. The CCCs help to structure student thinking so that they focus on specific aspects of the phenomenon they are exploring which, in this case, is why is biological variability an important factor in the survival of a species. Additionally, as a result of the instructional shifts of the NGSS, this lesson was designed to be student-focused with the teacher serving as a facilitator. The goal is for students to "figure it out" rather than just "learn about" the concept.

This is a low-budget and engaging activity, but you need to make sure to warn students against eating raw kidney beans (this can make them very sick) and throwing the beans (as they will need each bean in the bag). Be sure to have the 50 kidneys beans separated before the students arrive - this will save you time in class.

The accompanying guide-sheet is designed to lead your students through each step of the lesson and by the time the lesson is completed, the whole sheet should be filled out. Lastly, students need to be careful with the measurements in order to collect good data AND think about the implications of the ideas within the lesson.

It is my sincere hope that this lesson can lead to a better appreciation of biological diversity, including diversity in the human population. As EO Wilson wrote: "Humanity is strengthened by a board portfolio of genes that can generate new talents, additional resistance to diseases, and perhaps even new ways of seeing reality. For scientific as well as for moral reasons, we should learn to promote human biological diversity for its own sake instead of using it to justify prejudice and conflict."

Good luck and please reach out if you have any questions, upeguid@cfschools.net and https://upegui.weebly.com/