

## Teachers notes

### Is there variation within species and if so, why is it important?

The goal of this hands-on activity is for students to reinforce the idea of variation within a population or species. In the finch activity students observed variation in beak depth. Here they will measure different traits in three different organisms: pea size, femur length in grasshoppers, and reaction time in humans. These are just three easy traits to measure, but feel free to use other traits/species.

At the end of each activity students will graph their data (histogram), look for patterns in the distribution and answer the question: Why is variation important?

With this activity we want to help students recognize that variation is crucial for understanding natural selection –variation must already exist to be selected.

#### Materials:

- Preserved grasshoppers from Carolina Biological (Item # 225594)
- Hand magnifying lens or dissecting microscope.
- English garden peas\*: one pod per student (about 1#/class). Alternatively use sugar snap peas, 2 pods per student.
- Small mm rulers: one per student
- Meter sticks: one per two students
- Paper towels to put peas on while measuring.

\* **Note:** Purchase English peas in summer, usually available in August but start looking in July. Freeze until needed. Transfer to refrigerator the day before you plan to use them. Thawed peas are wet. Have students work with them on paper towels.

#### Preparing students for the lab:

1. Students will graph their data in a histogram to show the distribution of variation. They will bring some experience from reading the finch graphs, but some more guidelines might be necessary.
2. Students will need two sets of data tables for this lab –one set for their individual data and another for the group data. Since they are not intuitive to figure out you will need to give some guidance.
  - a. Individual data tables: similar to the below for each of the 3 things they will measure (pea diameters, grasshopper femurs and reaction times). In the tables they will need about 10 boxes for peas, 4 boxes for grasshopper femurs, and 6 boxes for reaction times (5 trials + average).

Pea Diameter (mm)										
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- b. Group data tables: sample is shown in the student handout but you will need to tell them the ranges to include in each (tables provided):
  - 1) Peas: smallest 2.0 mm, largest 13.5 mm
  - 2) Grasshopper femurs: smallest 20, largest 43
  - 3) Reaction times: smallest 0-1cm, largest 34-35cm.

### SET-UP (per table of 4):

4 small mm rulers, 2 hand lenses, 2 meter sticks, 2 petri dishes

Class:

1. **Peas:** Each person will measure 2 pods to the nearest 0.5mm. Use the data charts for tallying peas

Two test tube racks (or more) lined up end-to-end. Fill front row with large test tubes –one for each possible pea diameter. Place racks on a strip of paper labeled with pea diameter for each test tube.

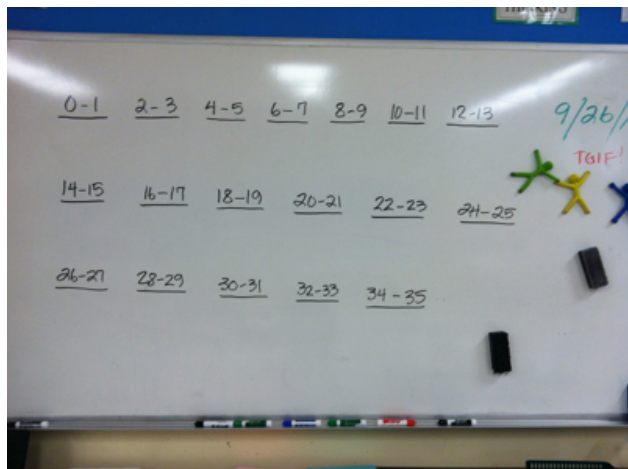
- If using English peas for 5 classes you will need very large test tubes ( $\approx 1"$  dia., 8-10" tall). Students measure all peas in one pod.
- For snow peas and/or fewer classes, smaller test tubes are better for showing the effect. If you have a small number of students, have them measure the WHOLE pea and put the whole thing in the test tubes to better see the effect.

Students will put the half of each pea they measure (or whole, see above) into test tubes according to its size. After all classes have added the peas the result will be a "living graph" showing two distinct patterns:  
1) all .5mm sizes will have fewer than the whole mm sizes (most likely due to error)  
2) the whole mm peas form a bell curve.

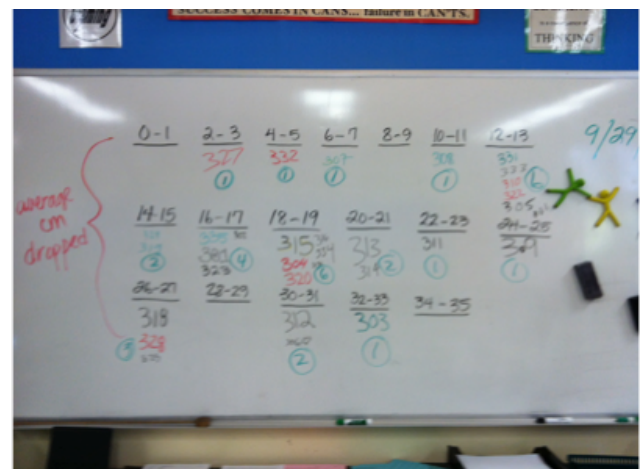


If you aren't on block schedule you may need to keep these over night to discuss the next day. If so you will need to cover them with their lids or foil and place in the fridge over night so you don't attract vermin.

2. **Grasshoppers:** Each group will measure 15 grasshopper femurs to the nearest mm. Use the data charts for tallying.
3. **Reactions times:** Each student will be measured five times. Categories written on the board where students can write their initials (or in my class, student #) under their average reaction time:



Before



After

## Wrapping up the lab

1. In this lab students graph the combined data from all of your sections. Students should be able to finish all the measurements in one class period however they will need to get the all-class data from you the next day.
2. You might want to explain students how to calculate the average or an approximation to the average.

## Post-lab discussion:

- This is a good moment to discuss patterns in data: they may reflect a pattern in nature, but as with the peas they can also reflect systematic error (reflected on the fewer peas that fall into the 0.5mm categories)!!
- Discuss the pattern, usually a bell or skewed bell shape. We tend to see more individuals that fall close to the middle (the average tends to fall around middle), and fewer farther out to the right and left of the center.
- Use the opportunity to discuss why we use averages. See Note about average below.
- If you have several periods when combining the data you can discuss the effect of sample size.
- Speculate on the possible benefits of peas being larger or smaller, grasshoppers having larger femurs and students having faster reaction times. This traits might not be advantageous/disadvantageous now, but what if the environment changes?
- There are many topics to discuss and usually not enough time. The most important idea to reinforce is that variation in traits is important for populations and is crucial for natural selection – variation must exist to be selected.

## Note about averages:

A population of organisms almost never consists of individuals that are all exactly the same. However, we tend to describe a population in general terms and use averages to describe a particular trait. For example, in our finch activity the beak depth average was 9.2 mm in 1976 and changed to 9.7 mm in 1978. The average helps us compare both populations indicating that the population in 1978 tended to have larger beak depths compared to the population in 1976. Despite we use the average (one single number) to describe a trait in the population, there is considerable variation among individuals and this variation is important. During the drought finches with larger beak depth had higher chances of survival than those that had smaller beaks.