UNIT 3

CHAPTER 12

Preparation

Each lab group needs 50–55 peanuts in the shell, 20 mung bean sprouts, and 10 tree leaves of the same species. Soak the mung beans overnight in cold water to prepare them for sprouting. Place the beans on a screen over moist paper towels or directly on moist paper towels in a baking dish. Rinse daily to prevent microbial infection. Grow the beans in a warm, dark place for 3–4 days until the sprouts are 1–3 cm long. Keep them moist.

Procedural Notes

- Two 40-minute periods are required to complete this investigation. Have students work in groups of two.
- Review the construction and labeling of a bar graph.
- During the first period, have students make the measurements for Parts A, B, and C and record their data. During the second period, have students graph their data and answer the questions.
- To compile class data, record each group's data for forearm length, leaf-blade length, and leaf-petiole length on the chalkboard. Pooling the data will increase the sizes of the populations studied, thus making students' statistical analyses more valid.
- **Safety:** Make sure that the leaves you collect are from a nonpoisonous species. Caution students to wash their hands before leaving the lab.

LABORATORY Investigation Chapter 12

Recognizing Patterns of Variation

OBJECTIVES

- Observe genetic variation in particular traits among members of a population.
- Infer how individual variation can potentially contribute to the continuing evolution of a species.

PROCESS SKILLS

- measuring
- calculating means
- organizing data in tables and graphs

MATERIALS

- metric ruler
- mung bean sprouts
- graph paper (optional)
- peanuts in the shell
- tape measure
- calculator
- tree leaves

BACKGROUND

1. How much variation in genetic expression exists within a population?
2. How might variation within a species be useful? How might variation be harmful?
3. How can variation within plant and animal populations be measured?
4. How is variation within a species the basis for natural selection?
5. Write your own question to explore in your lab report or notebook.

TECHNIQUE

Part A: Bean Sprouts and Peanuts

You will need 50–55 peanuts in the shell and 20 mung bean sprouts.

1. Measure the lengths of 20 mung bean sprouts to the nearest millimeter from the tip to the site where the sprout first emerged from the seed.
2. Record your measurements in the **Records** section of your report. Organize your measurement values on a single line from the lowest to highest value. Beneath each value, write the number of sprouts of that length. On your report or on graph paper, make a graph showing the distribution curve.
3. Crack open the peanut shells and measure the lengths of 100 peanuts to the nearest millimeter. Record your results in a table in the **Records** section of your report, giving the lengths and the number of peanuts of each length.
4. Make a bar graph using your data.

Part B: Humans

5. Using the tape measure, measure your lab partner's left forearm from the wrist bone to the elbow. Record your measurements in the **Records** section of your report. Pool your data with those collected by others in your class. In the **Records** section of your report, make a bar graph listing the measurements on the horizontal axis and the number of forearms of each length on the vertical axis.
6. Calculate the mean forearm length. Record your results in the **Records** section of your report.

Part C: Tree Leaves

You will need 10 tree leaves collected from one tree species.

Background Answers

1. Most populations show a great deal of genetic variation.

2. Variation helps a population of a species adapt to changes in the environment. Individual variations that are harmful mutations may cause the death of many individuals but are not likely to destroy a population.

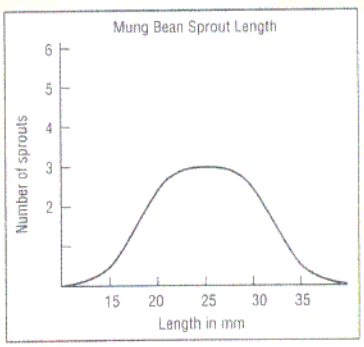
3. Variation within a population can be measured by comparing the traits of the individuals that make up the population.

4. Individuals with variations that make them better adapted to their environment are more likely to survive and reproduce.

5. How much variation exists in traits of genetic populations within a species?

Records

Bar graphs for parts A, B, and C should resemble the following sample graphs.



7. Measure the lengths of each of the 10 leaf blades. Record your results in the **Records** section of your report.
8. Measure the petiole (leaf stem) of each leaf and record the data in the **Records** section of your report.
9. Using the data from all class teams, record the lengths for the blades and petioles, beginning with the shortest length and ending with the longest length. Record your results in the **Records** section of your report. Briefly summarize the procedure you followed.
10. Clean up your materials and wash your hands before leaving the lab.

INQUIRY

1. What is the range of measurements for your mung bean sprouts?
2. The mode is the most frequently occurring value. What is the mode for your bean sprouts?
3. List the advantages and disadvantages for survival of the longest sprouts.
4. Analyze the bar graph showing the lengths of peanuts. Compare the numbers of peanuts of average length with the numbers of very large and very small peanuts.
5. Since the peanut supplies the seed embryo with energy, what is the relationship of peanut size to the amount of energy available to the peanut embryo?
6. For Part B, calculate the difference between the lowest measurement and the mode and the difference between the highest measurement and the mode. How does the mode differ from the mean?

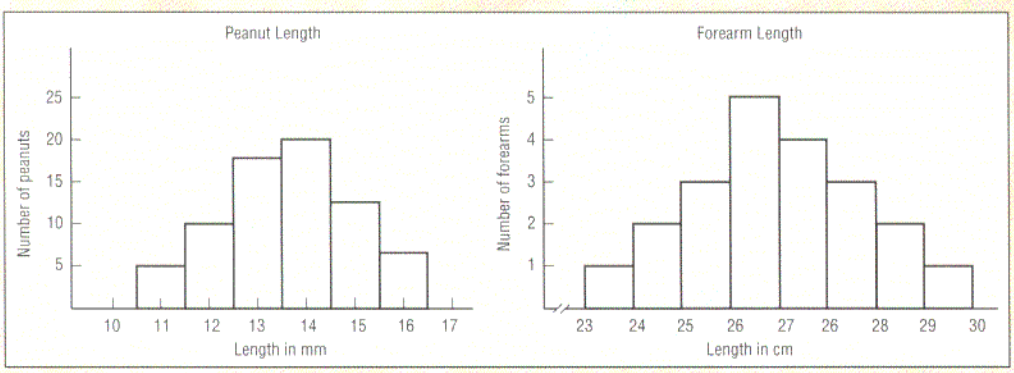
ANALYSIS

1. What is variation?
2. Explain why it is advantageous for a species to show variation among individuals.
3. Describe the relationship between natural selection and variation.
4. If the environment changed so that a very large peanut was an advantageous variation, what would happen to the peanut population over time in response to such a change?
5. Describe an environmental change that would favor a much larger peanut. Can you think of a change that would favor a much smaller peanut?
6. How might leaf size be important to the success of a plant?
7. How might you determine whether a trait such as those measured in this lab investigation is a result of genetic or environmental factors?

FURTHER INQUIRY

Write a new question that could be explored as a new investigation. The following is an example:

What are some examples of variations found in other species? For example, measure adult human height, pine needle length, acorn weight, or the length of the hind legs of grasshoppers. For each characteristic measured, hypothesize about environmental changes that could lead to the selection of an extremely small or large size.



CHAPTER 12

Inquiry Answers

1. Answers will vary. (Note: The range is the difference between the longest and the shortest mung bean sprout.)

2. Answers will vary.

3. Answers will vary. Longer sprouts can collect more sunlight but are more likely to be injured.

4. More peanuts will be of about average length.

5. The larger the peanut, the more energy there is available to the embryo.

6. Answers will vary. The mode is the most common measurement, while the mean is the average of all measurements.

Analysis Answers

1. Variation is the differences in the expressions of genetic traits among the individuals of a population.

2. Variation within a species is advantageous because it enables the populations of the species to adapt to changes in their environment.

3. Natural selection acts upon the variation within a population.

4. Over time, most of the peanuts produced by the population would be very large.

5. Answers will vary. Large peanuts might be favored if an environment suddenly had less sunlight for photosynthesis. Small peanuts might be favored if an environment suddenly became much drier.

6. Answers may vary. In environments where light is limited, larger leaves enable plants to gather more sunlight and grow larger. In hot, dry environments with plenty of sunlight, smaller leaves enable a plant to limit water use and still collect plenty of sunlight for growth.

7. You can determine whether a trait is genetic or not by observing whether it is passed on to offspring.