SCOPE, SEQUENCE, and COORDINATION

A National Curriculum Project for High School Science Education

This project was funded in part by the National Science Foundation. Opinions expressed are those of the authors and not necessarily those of the Foundation. The SS&C Project encourages reproduction of these materials for distribution in the classroom. For permission for any other use, please contact SS&C, National Science Teachers Association, 1840 Wilson Blvd., Arlington, VA 22201-3000.

Copyright 1996 National Science Teachers Association.

SCOPE, SEQUENCE, and COORDINATION

SS&C Research and Development Center
Gerry Wheeler, *Principal Investigator*
Erma M. Anderson, *Project Director*
Nancy Erwin, *Project Editor*
Rick McGolerick, *Project Coordinator*
Arlington, Va., 703.312.9256

Evaluation Center
Frances Lawrenz, *Center Director*
Doug Huffman, *Associate Director*
Wayne Welch, *Consultant*
University of Minnesota, 612.625.2046

Houston SS&C Materials Development and Coordination Center
Linda W. Crow, *Center Director*
Godrej H. Sethna, *School Coordinator*
University of Houston-Downtown, 713.221.8583

Houston School Sites and Lead Teachers
Jefferson Davis H.S., Lois Range
Lee H.S., Thomas Ivy
Jack Yates H.S., Diane Schranck

California Coordination Center
Tom Hinojosa, *Center Coordinator*
Santa Clara, Calif., 408.244.3080

California School Sites and Lead Teachers
Sherman Indian H.S., Mary Yarger
Sacramento H.S., Brian Jacobs

Iowa Coordination Center
Robert Yager, *Center Director*
University of Iowa, 319.335.1189

Iowa School Sites and Lead Teachers
Pleasant Valley H.S., William Roberts
North Scott H.S., Mike Brown

North Carolina Coordination Center
Charles Coble, *Center Co-Director*
Jessie Jones, *School Coordinator*
East Carolina University, 919.328.6172

North Carolina School Sites and Lead Teachers
Tarboro H.S., Ernestine Smith
Northside H.S., Glenda Burrus

Puerto Rico Coordination Center*
Manuel Gomez, *Center Co-Director*
Acenet Bernacet, *Center Co-Director*
University of Puerto Rico, 809.765.5170

Puerto Rico School Site
UPR Lab H.S.

* * * * * * * * * * * *

Pilot Sites
Site Coordinator and Lead Teacher
Fox Lane H.S., New York, Arthur Eisenkraft
Georgetown Day School, Washington, D.C., William George
Flathead H.S., Montana, Gary Freebury
Clinton H.S., New York, John Laffan*

*not part of the NSF-funded SS&C Project.

Advisory Board

Dr. Rodney L. Doran (Chairperson), University of Buffalo

Dr. Albert V. Baez, Vivamos Mejor/USA

Dr. Shirley M. Malcom, American Association for the Advancement of Science

Dr. Shirley M. McBay, Quality Education for Minorities

Dr. Paul Saltman, University of California-San Diego

Dr. Kendall N. Starkweather, International Technology Education Association

Dr. Kathryn Sullivan, Ohio Center of Science and Industry

Project Associates

Bill G. Aldridge
SciEdSol, Henderson, Nev.

Dorothy L. Gabel
Indiana University

Stephen D. Druger
Northwestern University

George Miller
University of California-Irvine

Student Materials

Learning Sequence Item:

1002

Genetic Variability

May 1996
Adapted by: Diane Schranck

Contents

This micro-unit was adapted by **Diane Schranck** (Jack Yates H. S., Houston, Texas)

Student Sheet

Science as Inquiry

The Peppered Moth

Is this an example of industrial melanism?

Overview:

With the coming of rudimentary technology, the world's atmosphere began to change. The burning of coal in England during the Industrial Revolution caused a shift in the population of the mottled colored Peppered Moth.

Procedure:

Prepare materials (provided) for "rounds." The large sheet of construction paper represents the ground. Cut out four $1^1/_2$ x 11 strips of black and of white construction paper for a total of eight strips of paper. These strips of paper represent trees. Punch-out black and white dots from the remaining construction paper (100 of each color). These dots represent moths. Label one cup as your pouring cup (successful reproduction) and the other as your reserve cup.

Listen to your teacher as he/she reviews the story of the Industrial Revolution in England and follow the instructions closely. As you proceed through the rounds, describe what condition you believe your trees are in—and how many black tree strips you should place on the background paper for the next round—as well how many moths you now have. Record your results for each round (as instructed) on a data table.

Round 1. Pre-Industrial Revolution

In this pristine world, there was little smoky pollution. The trees were unaffected by wood smoke and by the little coal that was burned in some homes for heating.

Round 2. Early Industrial Revolution

In the early stages of industrialization, England experienced an increase in coal smoke pollution. The stuff stuck everywhere, choking out the lichen and turning everything dark.

Round 3. Mid-Industrial Revolution

As pollution continues, the number of dark trees and rocks increases.

Round 4. Late Industrial Revolution

Now things are really getting bad. Coal smoke hangs in the air. Water from clothes being washed has a definite coal color tinge and the smell is in the air.

Round 5. England at Its Worst

The eyes burn from the pollution. Mucus from the nose is darkened. Tree bark—and trees—darken and die. Factories burn hundreds of tons of coal everyday in manufacturing. The lichens have all died.

After completing this activity, read "Evolution's Link to Development Explored" (Reading 1).

Questions:

1. In the predator-prey relationship involving peppered moths and birds, which is the predator and which is the prey?

2. By the late 1890s, black moths formed more than 95% of the population in English industrial areas. As new modern air pollution controls attempt to clean up the air and have an impact on air quality, what do you think might happen to the number of black peppered moths? What do you think might happen to the number of white peppered moths? Explain your answers.

3. Charles Darwin believed that evolution was such a slow process that it could never be observed directly. The observations of the peppered moth show that he was wrong. The force that causes this change is called Natural Selection. The tendency for dark-colored forms to replace light colored forms in polluted areas is called industrial melanism. This tendency has also been observed in some 100 species of moths in the Pittsburgh, Penn. area, where industrialization is heavy. Explain the changes in the population of dots as the rounds progressed.

4. How did the inheritance of the mutant dominant black gene affect the moths?

5. Humans are constantly altering the environment. How do these changes affect other organisms?

Science as Inquiry

That Pesky Gene

Can we ever get rid of the undesirable gene?

Overview:

Who would have believed that the wild weed with a small seed head that was called “maize” several thousand years ago would one day become the ear of corn that we know today. Not too long ago, beef cattle were bred with a lot of fat on the meat because it was felt that the fat gave the meat a good flavor. Today, we know that the fat adds to the problems of high cholesterol and heart disease. In response to increasing health concerns, cattle ranchers started breeding cattle for a lower fat content, consequently we are able to purchase much leaner meat than a few years ago. Virtually everything that we eat is a product of tampering with an organisms genes until the desired traits are produced. We even have Broccoflower which has a milder flavor than cauliflower, the coloration of broccoli and the formation of cauliflower. We have square tomatoes because they pack better from the farm. However, in order to do this type of selective breeding, a farmer, rancher or laboratory technician must do careful experiments to select for the desired traits. In this exercise, you will be that farmer trying to come up with a new and improved type of plant.

Procedure:

You have been given 3 cups and some red and white beans.

Round 1. Create a chart listing the possible bean color combinations of red/red, red/white and white/white (see sample table below). Count out 50 white and 50 red beans and determine the gene frequency of each (50 / 100 = 0.5), and record your beginning gene frequencies. Put 25 white and 25 red beans into two cups (representing parents) and gently mix the beans.

Without looking, draw one bean from each cup and record the resulting combinations on your chart. Once all the beans have been paired and counted, remove all of the w/w bean combinations and place them in the third cup.

Round 2. Calculate the new gene frequencies for the remaining beans. Count the new number of white beans and record the number. Count the total number of beans (red and white) and divide this total into the new number of white beans. This is the white bean frequency.

Now, for the red bean frequency, subtract the new white bean frequency from 1.0.

Example:

White bean frequency. One student group had the following numbers: 15 w/w, 20 r/w, 15 r/r. After removing the w/w combinations there were 20 r/w and 15 r/r color combinations, with a total of 20 white beans and 50 red beans. They then divided the number of white beans, 20, by the total number of beans, 70, to get 0.285, which rounds to 0.29—or 29—the frequency of the white bean.

Red bean frequency. Subtracting 0.29 from 1.00 equals 0.71—or 71—the frequency for the red bean.

Now, gather enough beans of each color to equal the new gene frequencies. Divide these equally into the two cups—odd numbers could go into either cup as long as the total in each cup is equal. For example, cup 1 might have 14 white beans and 36 red, while cup 2 holds 15 white beans and 35 red. The total for each cup still equals 50 beans per cup. You must record the new gene frequencies before you begin to pull beans from your cups.

Rounds 3–5. Repeat the entire process to get an accurate understanding of the developing pattern. Graph your results with a line graph—one line for the white beans and one line for the red beans.

After completing this activity, read “Evolution’s Link to Development Explored” (Reading 1).

Questions:

1. How were the frequencies of the genes affected?

2. What sort of problems did you have with the white gene?

3. What sort of problem would the white gene cause if this was a true-life case of plant breeding?

4. Create a new food plant. What sort of existing plants would have to be bred together to produce this new plant? How would you describe your new plant for advertising purposes?

5. Draw your plant and its parents in such a fashion that it clearly shows that your new plant is a result of its parents. Draw in the desirable traits inherited from each parent.

Student Sheet

Science as Inquiry

To Mutate or Not to Mutate

Why aren't we all alike?

Overview:

If we all looked the same—all the trees, dogs, cats, and other plants and animals were the same—this would be a pretty dull world. How did we get such a variety of things? Why did some variations survive? In this activity, you will be given the opportunity to take several measurements and consider possible advantages or disadvantages for each.

Procedure:

Part 1. Measure the germinated seeds to the nearest millimeter. Create a chart and record your numbers on it. Use this data to determine the range of measurements and the median. Create a graph and plot your data on the graph paper.

Part 2. Take the following measurements on your lab partner and record the measurements on the chalkboard: 1) length of earlobe from the lowest point of the inside of the ear to the lowest point of the earlobe; 2) from tip of thumb to the tip of the little finger with the hand fully extended; and, 3) from center of the right eye pupil to center of the left eye pupil. Determine which unit of measurement is most practical. Find the median and create graphs for each characteristic.

Questions:

Part 1.

1. What kind of seedlings were you given to measure? How many seedlings did you measure? What was the median?

2. Expressed in millimeters, what is the difference between the lowest measurement and the median? Between the highest measurement and the mode? What is the range of your measurements?

3. Why do you think that some sprouts were shorter than others?

4. How might taller sprouts be helpful to survival?

5. Since these seeds were germinated in the dark, how would they be different from ones sprouted in the light?

Part 2.

1. What is the range of the length of earlobes in your class? What is the median measurement? How might the length of earlobes be advantageous for humans?

2. What is the range of measurements for the tip of thumb to tip of little finger for your classmates?

Student Sheet

What is the median? How did the measurements of males students differ from the measurements of female students?

3. What is the range of measurements for the eye pupil to eye pupil? What is the median? How might eye-width be an advantage?

4. List several other variations which occur in humans. Explain any that you think might have an advantage for the species.

5. Describe instances where humans have manipulated the genes of other creatures (plant or animal) to serve their own purposes. Explain your answer.

6. If you were a farmer or rancher, what sorts of characteristics might you find desirable in the plants and animals that you raise?