Understanding the Nature of Diversity and Speciation

Annotation
Students will have a chance to try to determine plant species through a series of experiments. Using common vegetables, students will cross various plants to determine whether or not they are the same species.

Problem: How can things that look so different be the same?

Hypothesis: ____

Primary Learning Outcomes
At the end of this lesson the student should be able to:

- Define a species.
- Carry out and experiment to test a hypothesis
- Identify differences that do not separate individuals in different species.
- Identify characteristics that will separate individuals into different species.

Assessed GPS
Characteristics of Science -
Habits of Mind:
SCSh2, SCSh3, SCSh4, SCSh5, SCSh6
Content:
SB2

Assessed QCC's
Science Technology and Society: 1, 3, 7.4, 7.5
Horticulture: 106, 119, 121

Duration
30 minutes each of several days spaced between plantings. Prep prior to lab at least 2 times – once 8 weeks in advance and once 4 weeks in advance.

Materials:
2-3 of the following types of vegetables: purple-top or white turnip, Chinese cabbage (napa cabbage or petsai), celery cabbage (pak choi) choi sum, rapini, turnip greens, mustard greens, collards, wild mustard. And fast plants.
Some non-related plant
2- liter soda bottles
small pots
Petri dishes or film canisters
Small paint brushes or beesticks
Soil mixture – (peat moss and vermiculite works well)

UNDERSTANDING THE NATURE OF DIVERSITY AND SPECIATION

Background

What does it mean for two species to be the same species? How can we prove that different individuals are members of the same species? In this exercise students will have a chance to try to determine species through a series of experiments. The current definition of species that is accepted by most scientists was developed by scientist of the 19^{th} century such as Charles Darwin and Alfred Wallace. Generally, a species is defined as a group of organisms that are able to produce fertile offspring through the exchange of genetic material (in plants this means pollination and fertilization. To test this definition of species, we are going to cross several varieties of plants with our fast grow B. rapa and observe the results of these crosses.

There are 6 common species of Brassica, each with different numbers of chromosomes carrying the genes which determine how the plant appears. Brassica rapa has 20 chromosomes, whereas other species have different numbers. Plants of the same genus having the same number of chromosomes are normally able to cross-pollinate (exchange genetic information), and thus form new species. Thus, we can understand how different forms of the same species have arisen. Many of these new species have appeared due to the processes of domestication and selective breeding at different times and in different cultures or parts of the world.

In this experiment we will cross various plants to determine whether or not they are the same species.

Procedure

Pre-lab preparation:

1. Purchase greens in a local store and place in a sealed bag in the refrigerator for four weeks.
2. Make a growing container for each plant by potting them in pots small enough to fit under the dome of a two liter bottle with the bottom cut off.
3. Fill pots with equal parts vermiculite (or sand) and peat moss.
4. At the end of four weeks remove plants from the refrigerator and place them in the pots of soil you prepared.
5. Cover the pots with the top portion of the 2-liter bottles cut to be about 8 inches tall. Leave the cap off of the bottle.
6. Allow 3-4 weeks for the plants to produce flowers. When the buds first appear plant the fast grow seeds – enough to have plenty to cross-pollinate. In two more weeks all should be flowering.
7. Cross-pollinate each plant with the fast plants by putting their pollen on a fast grow flowers. Pinch off all other blooms and buds. Record what crosses you made in your lab report book. Include pictures and names of the plants you used.
8. In 20 days or so you will have mature seed pods.
9. Separate seeds from seed pods keeping all seeds from the same plant together. Count the number of pods and number of seeds per pod for each plant. Store them on

separate pieces of green tape (masking tape will do). Be sure to label each tape with the appropriate cross information.

10. Germinate mature seeds in Petri dishes by moistening filter paper in the bottoms of the Petri dishes and placing the seeds on top. Be sure to label the Petri dishes with the appropriate crosses. Keep different crosses in separate Petri dishes. Germination may take a few days to occur. Count the number of viable seed each cross produced (viable means able to grow in this case). Record this information in your data chart.
11. Summarize your data in your data chart and then answer the questions on the assessment page.

Extensions

1. Carefully collect the germinated plants and plant them in soil. Cross-pollinate these and germinate them to see if you get seeds that are viable.

Adapted from: A Biological Riddle, 1989**.** Wisconsin Fast Plants, University of Wisconsin-Madison, College of Agricultural and Life Sciences Dept. Of Plant Pathology, 1630 Linden Drive, Madison, WI 53706

Assessment

1. Which of your crosses produced seed?
2. If the cross produced seed, is this proof to the parents being the same species?
3. Why did we only pollinate fast grow flowers?
4. Should the opposite cross produce similar results?
5. Which crosses produced viable seeds? Are these plants the same species?
6. How can you tell?
7. Hand in your data sheets with these questions when you have completed the lab.