California Foundation For Agriculture In The Classroom

Bird Land

(How Changes in Plant Life Can Affect Animal Life)

Purpose

This lesson uses role-playing and kinesthetic activities to introduce the concept of evolution through naturally occurring mutations. Students learn that some genetic mutations produce traits that are not advantageous while other mutations allow one species to survive while others become extinct. The students will examine how the environment can determine whether or not a genetic change is beneficial.

Time

2-3 forty-five minute sessions

Materials

- "Bird Land" activity sheets *(1 per student)*
- Brass fasteners *(100)*
- Paper Clips *(100)*
- Plastic spoons *(25-30)*
- Rubber bands *(100)*
- Small paper cups *(1 per student)*
- Toothpicks *(10-15)*
- Tweezers *(10-15)*

Background Information

This activity is based on Darwinian evolutionary theory. It would be helpful for the students to have a solid background on Darwin and his findings in the Galapagos Islands. The concept of "survival of the fitter/fittest" and the knowledge that genes can mutate (thereby changing phenotypes) are also important to this lesson.

The case of the peppered moth from Northern England can be used to show how a subtle mutation of a gene might result in a species-saving trait or phenotype. There were two varieties of peppered moths in pre-industrial Northern England. The dark-colored moth (ww) was a genetic variation of the light-colored moth (WW) or (Ww). The dark moths were barely surviving, as they were easily seen by predators. They were dark food items on light-colored tree trunks. As factory soot darkened the tree trunks, the white moths became more visible and were eaten in considerably larger numbers. The dark moths now had a sizable population advantage over the white moths of Northern England. In this case a genetic variation, which seemed nearly disastrous, became beneficial due to an environmental change.

It is important for students to understand that a mutation is an accidental change in the DNA of an organism and that most mutations occur naturally. Whether a mutation is beneficial is determined by the relative survivability of the species over time—or "naturally selected"over time. It might be appropriate to discuss several topical issues involving genetics and mutations. Some examples include:

- solar radiation and skin cell carcinomas
- dentists' lead blankets and x-rays
- tanning booths and skin mutations
- viral resistance in grape root stock
- nematode resistance in peach root stock
- ability of dogs to smell certain items such as mushrooms
- ability of plants to grow in high salt or acidic soils
- humans who carry the sickle-cell gene are resistant to malaria
- some strains of field corn are resistant to the corn smut fungus

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Content Standards

Grade 7

Science
- Evolution • 3, 3a, 3b, 3c, 3e
- Earth and Life History • 4g
- Investigation and Experimentation • 7a, 7c

Reading/Language Arts
- Reading • 1.0
- Written and Oral Language Conventions • 1.0

Mathematics
- Number Sense • 1.0
- Statistics Data Analysis and Probability • 1.0
- Mathematical Reasoning 2.1, 2.5, 2.8, 3.3

Grade 8

Science
- Investigation and Experimentation • 9a, 9b, 9c

Reading/Language Arts
- Reading • 1.0, 1.3
- Writing • 1.3, 1.5, 2.4b
- Written and Oral Language Conventions • 1.0

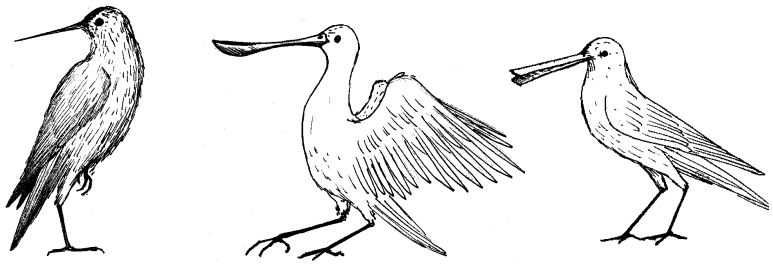
Procedure

Day 1

1. Have the students read the "Problem" posed on their student worksheets. Explain to the students that they will soon be transformed into three sub-species of birds: Tweezertweeters, Spoonbills and Woodpickers. Illustrate the three types of beaks—tweezers, spoons and toothpicks. Continue by explaining that these three bird groups have all evolved from one bird species over the course of several hundred thousand years. They have evolved three distinct beaks, tailored to the specific type of food found in the environment. Refer to Darwins' travels and his findings regarding the finches of the Galapagos Islands and/or the peppered moths of England.

2. Explain that each bird group has a beak that "fits" a particular food item. Show the students the food items (rubber band "worms," brass brad "bugs," and paper clip "silver slugs"). Ask the students to predict which of the foods might be eaten most easily by the Woodpickers and why. Discuss the other birds as well.

3. Once you have discussed the different types of food found in this environment, consider "hooking" the students into this role-play by creating a story. The following story is one of many that can be used. Alter the story to meet the needs of your students and classroom.



Woodpicker **Spoonbill** **Tweezertweeter**

Long ago, in a faraway land lived three unique bird groups: the Tweezertweeters, who used their tweezer-shaped beaks to pick up food; the Spoonbills, who collected food by scooping it up; and the Woodpickers who ate by piercing their food items. [At this point, you might want to ask volunteers to demonstrate their food collecting abilities. Have students hold a paper cup in one hand. The paper cup will represent the "mouth." The other hand will hold the appropriate item (tweezer, spoon, or toothpick) to represent the "beak." Pinching the food between the "beak" and "mouth" is unacceptable.]

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Content Standards
(continued)

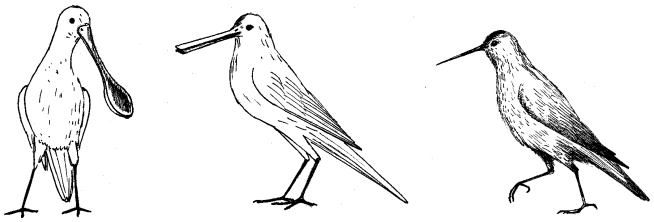
Grade 9

Science
- Genetics • 2, 6a, 6b
- Evolution • 7a, 7c, 7d, 8a, 8b, 8d
- Investigation and Experimentation • 1d

Reading/Language Arts
- Writing • 1.4, 2.4a
- Written and Oral Language Conventions • 1.0, 1.3

These three bird groups successfully lived together in the same area, for a long time. They had each evolved a different beak to capture a different type of food. To see how these groups live and eat together, we're going to have "lunch." [At this point assign the students roles to play, remembering that each bird group should be represented by about 1/3 of the class. Have volunteers spread out the food items (100 paper clips, 100 rubber bands and 100 brads), in random fashion, throughout the room. If appropriate, you may choose to complete this lesson outside.]

The birds feed in a very short period of time. This is because they are quite wary of predator cats. The birds are also extremely wary of each other. So . . . if one bird has its beak on a piece of food, the others will leave it alone (this will avoid unsafe "competition" for food!). *All types of birds are able to eat all types of foods even though their beaks might be able to obtain a particular type of food easier than others.*



4. Distribute the bird "beaks" (toothpicks, tweezers, and spoons) and "mouths" (paper cups) to the students and let them "forage" for food for 2-3 minutes. Watch out for unfriendly competition and for unfair eating practices. At the end of the designated time, send the "birds" and their cups of food back to their "nests" (seats).

5. Have the three types of bird teams tally up their total numbers of gathered food items. Then as a class, tally up those numbers so you now know how many pieces of food each type of bird was able to eat. For example, the Tweezertweeters might have 10 members who, together, "ate" a total of 34 worms, 26 bugs and 35 slugs—for a grand total of 95 food items. Have students complete the *Eating Like a Bird* Data Table, Part 1.

6. After depositing their food in a collection bin, have the students discuss/answer the questions following the data table. Then, discuss aloud why even though some birds didn't compete for food as well as others, they still survived as a species. This is because there was plenty of food, and the birds were generally eating different food items.

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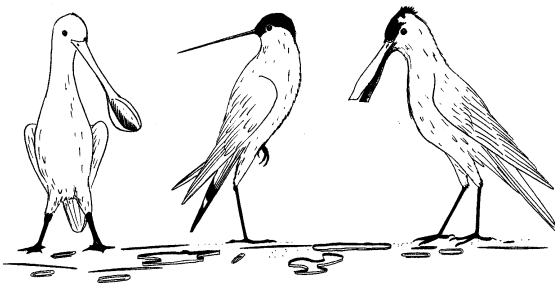
The story continues. . . *The area became infested with a variety of parasites which completely destroyed two of the three food sources—the paper clip slugs and brass brad bugs. Additionally, the rubber band worms had their numbers reduced by about 50%.*

Ask the students to refer to their last question from the previous feeding. What do they think will happen, now that this environmental change has occurred? What bird species is best able to deal with this change?



Day 2

1. Have the feeding process repeat, only this time have the birds compete for about 50 rubber band worms, spread throughout the environment.

2. Have the students complete the *Eating Like A Bird* Data Table, Part 2, then discuss and answer the conclusion questions. You may choose to assign this as homework or as an independent assessment of student knowledge.

   NOTE: Students should discover that the Tweezertweeters are the only survivors. The other groups, because of their beak structures, could not obtain enough food to survive. This lesson reinforces the concept of evolution as a naturally-occurring process and that some species cannot survive in a changed environment. Also discuss that, in reality, this process would occur over a long period of time.

3. Discuss that parasites affect agricultural crops. Relate the role-play scenario to the phylloxera calamity that has destroyed huge areas of California grape acreage. The pest, the phylloxera parasite, attacks the root systems of grape vines and destroys the plants. Vintners have somewhat successfully combated the problem by breeding for pest-resistant root stock and then grafting premium grape varieties to the improved root stock. The original phylloxera virus resistant root stock was a natural mutation that researchers and farmers are

taking advantage of. Also discuss that viruses are decomposers and that decomposers return nutrients back to the soil. If an environmental change killed all decomposers except phylloxera and all plants were resistant to phylloxera, then nutrients would not be able to be returned to the soil. The students should see that ecosystems are very sensitive and complex and are affected by many environmental and genetic factors.

Other agricultural discussions may include the threat of Pierce's disease to California's grape industry as well as other crops. Students can follow in the newspapers how researchers are working to develop reasonable control methods for this disease. The most likely methods may include developing plants that are resistant to the bacterium, *Xylella fastidiosa*, which causes the disease. Other possible control methods may include controlling the insect vector for this bacterium, the Glassy-Winged Sharpshooter.

Variations

- Use various colored items as "food." Have one group of animals be color-blind (wear safety goggles covered with colored cellophane) while another group of the same species possess color vision due to a natural mutation.

- Use items that are grass/lawn appropriate and do the activity outside.

- In part of the lesson, keep in a few brass bugs and silver slugs. This can show how some individuals in a population might have a genetic built-in tolerance of parasitic diseases. Relate this to penicillin-resistant strains of bacteria.

Extensions

- Have the students perform research on the common garden snail and find out why they are such persistent home garden and agricultural pests. Find out how this pest is controlled.

- Continue your story by telling the students that you were mistaken about the parasite. It was actually a rare fungus that attacked all of the lower forms of animal life and killed them off. As nature would have it, another species evolved—the Moldy Mushrooms (marshmallows). If this were the only food source to the birds, which species would have the advantage? Discuss how natural selection works in favoring one species over others. Those that are

better adapted to their new surroundings are better able to pass their genes on to future generations.

- Discuss real cases of potential or actual species extinction due to altered environments (peppered moths, carrier pigeons, spotted owls, etc.)

- Discuss the tomato as an agricultural example of natural selection and selective breeding. The tomato is the most common home garden plant and has an interesting history. Some interesting facts about tomatoes are described below:

  - Tomatoes were brought to Europe from South America by Spanish explorers.
  - Through cross-breeding programs, hundreds of different tomato shapes, sizes, colors and flavors are now available.
  - Tomatoes were once considered poisonous.
  - Joseph Campbell and his partner were the first to "can" a tomato and also the first to condense this fruit into a rehydratable soup.
  - Thomas Jefferson grew several varieties of tomatoes in his Monticello gardens.

- The tomato is a good example of natural selection. The many varieties of tomato allow it to survive in a wide range of habitats. Some naturally selected tomato mutations are described below:

  - A naturally selected Siberian tomato sets fruit at 38°F and ripens in 48 days.
  - A spontaneous mutation, in 1914, produced the bushy-type plant most gardeners seek.
  - Many wild tomato varieties have developed resistance to as many as 27 different tomato diseases. These traits are being bred into domestic varieties.
  - In the Galapagos Islands, a variety of wild tomato grows less than five yards from the ocean. It has the ability to survive in sea water.
  - In Peru, a drought-resistant tomato obtains all the water it needs from fog.

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Name _____

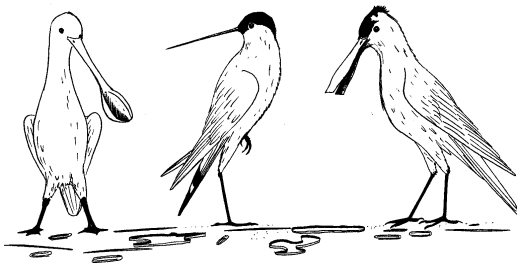
(A Model of Natural Selection)

Problem

How will a mutation (or environmental change) affect a group of birds and their ability to obtain food?

Procedure

Follow your teacher's directions to become one of three types of birds and work to obtain "food." Fill out the Data Table and answer the questions.



"Eating Like A Bird" Data Tables

Part I

Directions: Write the number of food items "eaten" in the boxes below.

Bird Species	Rubber Worms	Brass Bugs	Silver Slugs	Total Eaten
Tweezertweeters				
Spoonbills				
Woodpickers				

Conclusion

1. If each species needs at least 30 food items to survive, tell which species stayed alive.

   _____

2. Did one species of bird eat more than the others? _____ If so, which one?

   _____

   What advantage did this bird have over the others? _____

   _____

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Name _____

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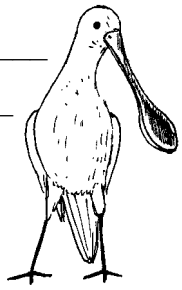
3. Predict what might happen to these bird sub-species if the amount of food available were drastically reduced because of a disastrous environmental change. Explain your thoughts.



_____

_____

_____

Part 2

Directions: Write the number of food items "eaten" in the boxes below.

Bird Species	Rubber Worms	Brass Bugs	Silver Slugs	Total Eaten
Tweezertweeters				
Spoonbills				
Woodpickers				

Conclusion

1. Each species needs 30 food items to stay alive. Which birds survived?

   _____

2. Give at least two reasons for the survival of one species over the others.

   a. _____

   b. _____

3. The human population continues to grow in astounding numbers. Think of one natural mutation that might assist the world with this challenge. Discuss its advantages and disadvantages. Be creative—there are no right or wrong answers.

   _____

   _____

   _____