

## 2.2.2 Helping Others Understand Evolution

### Overview

Scientists refer to evolution as a theory. The use of the word “theory” in science is different from the way we use the word in everyday life. In informal use, the word “theory” might be interchanged with the word “guess”. However, in science, a theory is a well-supported group of ideas that explains a large number of observations about the natural world. Other theories in science include the atomic theory and cell theory. When a scientific theory is put to the test, it is used to predict the occurrence of natural phenomena. When predictions prove accurate, the theory gains validity. After testing the theory of evolution since it was first suggested by Darwin and gathering evidence from a wide variety of sources ranging from the fossil record to molecular experiments, scientists fully accept this explanation of biological change, even as they investigate and debate some of its processes.

As you discuss evolution with others, it is helpful to be able to distill its key ideas into simple, dynamic experiences. In this activity, you will conduct a lesson with young students to introduce them to the idea of evolution and change over time. Specifically, you will be able to demonstrate how natural selection has played a part in Earth’s biological diversity.

### Learning Objectives

- Even though evolution is a complex theory, mechanisms of evolutionary change can be simulated using easy-to-understand activities, even at a primary school level.
- Humans are now part of the evolution equation in that they create new situations in which the mechanisms of evolutionary change work.

### Student Activity: Helping Others Understand Evolution

#### Materials

For each group:

1 plastic bag of 600 colored toothpicks, 150 each of red, yellow, green and blue

1 plastic bag of 600 colored toothpicks, 50 each of red and yellow, 200 blue, and 300 green

green, grassy area, a square about 5 meters on a side

light concrete paved area (not dark asphalt), a square about 5 meters on a side

#### Advance Preparation

Divide your class into two groups. Each group will work with half of a class of younger students.

Identify a class of younger students from your school or a nearby elementary school. For this activity, grades 2-4 would be ideal. Communicate with the teacher and schedule a time to visit during which you will conduct your activities. Decide where you will conduct the activity, both the green, grassy space and the light-colored, paved space.

Be sure that you have enough materials to conduct the activity with two groups. For each group, divide the colored toothpicks into the two bags of different mixtures of colors.

In the days preceding your class visit, practice your activity taking turns with your classmates being the “students” and the “teachers”. Decide how you will present each activity and who will do the instructions, materials management, student direction, and debrief. Plan to assign several members of your group to be student helpers who manage students throughout the activity. Always be organized before you travel to a class of younger students.

### Process and Procedures

1. Arrive to the classroom of younger students and introduce yourselves. Let them know that they will be divided into two groups, but each group will do exactly the same activity. Divide the class into two groups and meet with your group. Spend some time getting to know one another.
2. Begin the activity by asking students to name things that all animals need to live. Keep them talking until they have identified five major groups: food, water, shelter, space, and air. Make sure they realize that humans, who are animals, also need these things.
3. Take students out to the grassy area. Show them the boundary of the area by walking the edges and asking students to stand on the edges, facing in.
4. Scatter the first bag of 600 colored toothpicks (even numbers of all colors) on the grass square. Tell students that these toothpicks represent caterpillars that live in the grass. They are all the same kind of caterpillar, but they are different colors just like the students are all humans but have different hair color. Discuss how these caterpillars have everything they need here: food, water, shelter, space, and air.
5. Ask students to pretend that they are birds. Because they need food to survive, they like to eat the caterpillars. When you give a signal, they are going to “swoop” into the square and collect all the toothpicks (caterpillars) that they can find in 10 seconds. Tell students that they can only “eat” one caterpillar at a time (no scooping).
6. Give the signal and count for 10 seconds. At the end, say “Stop!” and ask students to return to their places on the outside of the grassy square.
7. Tell the students to divide the toothpicks they collected into four groups by color. How many red toothpicks did they get? How many yellow? Green? Blue? The students are

likely to pick up more yellow and red toothpicks than green and blue ones. Usually, they will collect the fewest green toothpicks.

8. Discuss why they got so many red and yellow toothpicks and so few blue and green ones. Why would it be an advantage to be a green caterpillar in a grassy area? Discuss how their color matches their surroundings and protects them by camouflaging them. Then, spend time collecting all the toothpicks from the grassy area. Remind students how much harder it is to find all the camouflaged green toothpicks! Ask students to put them in the bag for you.
9. Direct students to sit down on the grass. Ask them to think about these things:
  - What if there are more green caterpillars left safe in the grass, and they reproduce and make more green caterpillars?
  - What might happen over time to the number of green caterpillars in the grass compared to red or yellow caterpillars?

Then, show them the second bag of toothpicks, with many more green toothpicks than those of other colors. Tell them that the green caterpillars were eaten less, reproduced more, and their successful survival in the grass increased their numbers. The red and yellow ones more often were eaten before they could reproduce. Over time, the population of caterpillars has changed.

10. Walk students over to the paved area. Show them the boundaries and ask students to stand along the edges like they did around the grassy square.
11. Toss the “caterpillars” from the new bag (more green than any other color) out on to the paved area. Ask students to tell you what they notice. Which toothpick colors are more obvious in this new environment?
12. Ask students to discuss this space: What color is it? How is it the same and different from the grassy square? Is it an advantage to be a green caterpillar now? If the students were birds flying far up above the square, which caterpillars would they see most easily?
13. Ask the students to sit down around the square. Discuss a change that humans often make to an environment: they pave over wild areas to make parking lots, streets, and sidewalks. Then, ask these questions:
  - Would this change endanger green caterpillars?

- If many more green caterpillars were hunted and eaten by birds because they could be seen easily on pavement, would the green caterpillars decrease in number? What might happen to the yellow caterpillars now?
- If both grassy and paved areas existed, where might more green caterpillars live? Where might more yellow caterpillars live? What about the other colors?
- If only paved areas existed, and all wild areas were paved over, what could happen to the green caterpillars over time?

14. Discuss with the students that the changes that humans make to the wild areas could make the population of caterpillars change so that they don't have as many colors. Eventually, maybe all caterpillars would be only the lightest colors. Let students know that this change over time is known as evolution and the gradual change towards a more advantageous color happens because of a process called natural selection. Natural relationships among animals allow the healthiest individuals that best fit into the environment to grow up and reproduce and pass on their characteristics, like color.
15. Finish the activity by asking students to help you pick up all the toothpicks and put them into the plastic bag.

### Assessment

Teaching a topic to another person always reveals your own misconceptions. During your group's activity with the younger students, you might have wished that you were clearer in your explanations or that you had been able to go a little deeper to help the students understand evolution and natural selection. You might have even explained something incorrectly.

Write a letter to a younger student following your visit and activity. Explain the caterpillar and bird activity in your own words so that you are certain that the reader will understand both the idea of evolution and the mechanism of change called natural selection. Use one additional example from real life to help the younger student see evolution and natural selection in a new context. Use standard letter format and neatly handwrite or type your letter. Once all the letters are written, have your teacher send them to the classroom of younger students. Welcome their questions and keep up a dialogue.

## Expected Outcomes

### **What's the take-away?**

Breaking down a complex topic to explain to young learners often serves to deepen one's own understanding of a topic. The theory of evolution is a complex one, but using the modeling process can help illuminate some of its most important core ideas. Living things change over time, often for logical and identifiable reasons. The activity models how the small differences and changes in living things can have an impact on their overall survival.

### **What does the student work product look like?**

Preparation will be the key to success in this activity. Be sure that students have ample time to rehearse teaching the lesson before they implement the activity with the younger students. Consider suggesting students use index cards with written reminders to help them teach a successful lesson.

### Assessment

Each student will generate a written explanation that summarizes the key points of the activity. Students should keep in mind their audience (the younger children) when they are writing the letters and use appropriate vocabulary and sentence structure to explain the concepts to them at their level.