

Investigate Natural Selection

What characteristics help organisms survive and reproduce over time? The theory of natural selection demonstrates how genetic variation within a species provides different traits. These traits help certain members of a population survive and reproduce and pass on these traits to the next generation. How are these traits selected for within a population? Do the biggest and toughest members of a population always pass on their traits?

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Student Prior Knowledge

Students should be familiar with the process of natural selection and the concept of “survival of the fittest.” It is important they understand what heritable traits (variation within a species) are and how they are passed on from one generation to the next. This knowledge helps students understand how competition within a population can lead to evolutionary change within that population over time.

**Suggested
Timeline**

40-50 minutes



FOCUS QUESTION

*How do inherited traits
impact survival?*





Materials

- CER Reflection sheet, p. 42, 1 per student
- Survival of the Fittest Data Record sheet, p. 41, 1 per student
- Survival of the Fittest Predictions sheet, p. 39, 1 per student
- Survival of the Fittest Simulation sheet, p. 40, 1 per student
- plastic cup (for stomach), 1 per student
- dry beans, 1 cup with 4 types per group
- beak options*
 - chopsticks, 1 set per group
 - plastic forceps, 1 pair per group
 - plastic spoons, 2 per group
 - paper clips, extra large, 2 per group

*alternative: Any suitable items can become a beak, such as 2 plastic forks, 2 pencils, and so forth.

Teacher Preparation

- Print the Survival of the Fittest Data Record, Predictions, Simulation, and CER Reflection sheets.
- Prepare group materials: 1 cup of four varieties of beans, 4 cups, 2 plastic spoons, 2 extra-large paper clips, 1 set of chopsticks, and 1 pair of plastic forceps.

PROCEDURE

1. Introduce the topic of natural selection by survival of the fittest. Ask each student what they think “survival of the fittest” means. How can one organism do better (outcompete) than another organism in its environment? If an organism is able to perform better, what does that mean for that organism? How will it pass on this advantageous trait to the next generation?
2. Ask students what an organism’s basic needs are. Ask them to discuss this with a partner and respond to items 1–4 on the Survival of the Fittest Predictions sheet.
3. Distribute the food, beaks, and cups to student groups. Let students explore the beak types and food for a few minutes. Each student uses the same beak throughout the entire simulation. Based on their observations, ask students to write a claim about their beak’s ability to consume food. Will they survive (be able to consume enough food) to reproduce and pass on their heritable trait?
4. Play the Survival of the Fittest Simulation. Each round is 60 seconds long.

Round 1: Self-assessment

Dump 1 cup of beans on the student group table (if this is too messy, dump the beans into a large box to help keep it on the table). Taking turns, each student uses their beak to “eat” beans to determine how much they can eat in 60 seconds, and then records the data on the Round 1 chart. Note: Students must pick up each bean individually and place it in the cup without scooping it into the cup. One hand must hold the cup; the other hand must hold the beak. Dump the beans on the group table to replenish the food supply before each person takes a turn.

Round 2: Group assessment

Group assessment: Dump 1 cup of beans on the student group table. For 50 seconds, all members of the group should try to “eat” at the same time. Record the data on the Round 2 chart.

Round 3: Class assessment

Make room on the classroom floor for this round. Ask students to stand in a circle with their beaks and stomachs ready. Dump 1 cup of beans per group onto a large open space (floor). Each student tries to “eat” as much as they can in 60 seconds. Record the data on the Round 3 chart.





5. Ask students to analyze class data to determine which beak type (trait) performs best. Which beak type is most successful? (Alternatively, students can examine food data. Food sources are plants that reproduce. Which food type is most successful and can survive into the next generation to reproduce?)
6. Next, ask students with the best-performing beak type to stand. Are these students the “biggest” or “toughest”? Are there surprises? Ask students to complete the CER Reflection sheet based on the collected data.

Active Questions

1. Are all of the organisms in a species exactly the same?
2. Do species change over time?
3. What is needed for organisms to change over time?
4. What variations (heritable traits) are present in the Survival of the Fittest Simulation?
5. How does the process of natural selection work within a population?
6. As competition for local resources increases within a population, what changes might you see?
7. As time progresses and heritable traits continue to be selected for, what happens to the trait frequency within a population?

Differentiation

Adjust the activity to best meet your students' needs.

- Differentiate according to the fine motor skills of your students. It might be necessary to use only large beans and/or spoons as beaks.
- Provide only one bean and one beak type to a student group to determine alternative heritable traits, such as agility, eyesight, or behavior (competitiveness).
- Provide students with predetermined data for analysis in lieu of modeling lab participation.
- Assign point values for each bean, for example: lima beans = 1 point; pinto beans = 2 points; navy beans = 3 points; soybeans = 4 points. (More points are given for the protein value of the bean, although they are ranked 1 to 4 by how easy to “eat” they are.)

Suggested Wrap-Up

Ultimately, if competition drives how traits are selected for within a species, what happens to a species when competition ceases to exist? For example, food and water are supplied constantly to turkeys and chickens in a modern poultry house.

- Ask: “How does this impact natural selection?”

Teaching Suggestions

Round 1 is a self-assessment. Students should focus on the best method to use their beak to capture food.

Round 2 is a group assessment. This round increases competition (pressure) within a population. To encourage competition, ask students to stand around their group table and race to gather food before their 60 seconds is up. Have the group closest to them keep time and watch their progress to alleviate cheating (scooping into their stomachs). Then, have the groups switch roles.

Round 3 is a class assessment. It is important to provide a large enough space for each student to have access to the food in the interior of the space. To encourage competition, ask students to stand around the space and race to gather food before their 60 seconds is up.





MORE CHALLENGES

- Ask students to watch the video at youtu.be/s64Y8sVYfFY and describe how natural selection has led to new finch species on the Galapagos Islands.
- Explain how black pepper moth coloration changes from year to year depending upon predation. A Peppered Moth Game is available from Arizona State University: askabiologist.asu.edu/games-sims/peppered-moths-game/play.html.

SUPPORT INFORMATION

The Theory of Evolution by Natural Selection

- **Variation.** Members of any given species are seldom exactly the same, either inside or outside. Organisms can vary in size, coloration, the ability to fight off diseases, and countless other traits.
- **Inheritance.** When organisms reproduce, they pass on their DNA (the set of instructions encoded in living cells for building bodies) to their offspring. Many traits are encoded in DNA; therefore, offspring often inherit the variations of their parents.
- **Selection.** Environments cannot support unlimited populations. Because resources are limited, more organisms are born than can survive. Therefore, some individuals are more successful at finding food, mating, or avoiding predators, and these individuals have a better chance to thrive, reproduce, and pass on their DNA. Small variations can influence whether or not an individual lives and reproduces.
- **Time.** In generation after generation, advantageous traits help some individuals survive and reproduce. These traits are passed on to greater and greater numbers of offspring. After just a few generations or after thousands of generations, advantageous traits become common in the population.
- **Adaptation.** The result is a population better suited—better adapted—to some aspect of the environment than it was before.

The Survival of the Fittest Simulation is one way to explain biological fitness, the ability of an organism to reproduce and pass on its DNA to the next generation. Therefore, “survival of the fittest” means the fittest organism in a population is the organism able to breed and reproduce the most successfully.



Home Connection

How are modern poultry farms changing the necessity for variation among poultry for production needs? How are consumer choices (white meat preferences, food costs, etc.) related to trait selection in poultry for commercial production?





CAREER CONNECTIONS

What types of poultry professionals help make healthy, safe environments for commercial birds? Discuss the poultry scientist career with your students.

Poultry scientists apply principles of the biological, physical, and social sciences to the problems associated with poultry production and management. In other words, they study animal health and behavior to help design efficient and sustainable environments for commercial birds to live in and produce high-quality meat and eggs.

