

# Investigating Natural Selection

## Lesson Plan

### **Subject(s)**

Natural Selection

### **Grade Level**

Middle – High School

### **Duration**

~60 min

### **Rationale**

This inquiry-based learning activity on natural selection will help students establish a basic understanding of natural selection. Discussion of current happenings involving the concepts of natural selection and evolution will illustrate the importance of Darwin's theory in today's society.

### **Activity Summary**

Students investigate the predator-prey relationship as an example of how natural selection occurs in a population. Relate natural selection to current happenings.

### **Objectives**

1. Students will be able to explain natural selection – how certain individuals survived and passed on their genetic information.
2. Students will be able to relate natural selection to current happenings (antibiotic resistance, endangered species).

### **Standards**

#### **6<sup>th</sup> Grade**

SC-06-3.5.1

Students will explain that biological change over time accounts for the diversity of species developed through gradual processes over many generations.

Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

## **7<sup>th</sup> Grade**

SC-07-3.5.1

Students will:

- describe the usefulness of fossil information to make conclusions about past life forms and environmental conditions;
- explain the cause and effect relationship of the extinction of a species and environmental changes.

Extinction of species is common and occurs when the adaptive characteristics of a species are insufficient to allow its survival. Most of the species that have lived on Earth no longer exist. Fossils provide evidence of how environmental conditions and life have changed.

## **8<sup>th</sup> Grade**

SC-08-3.5.1

Students will draw conclusions and make inferences about the consequences of change over time that can account for the similarities among diverse species.

The consequences of change over time provide a scientific explanation for the fossil record of ancient life forms and for the striking molecular similarities observed among the diverse species of living organisms.

## **High School**

SC-HS-3.5.1

Students will:

- predict the impact on species of changes to (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, or (4) natural selection;
- propose solutions to real-world problems of endangered and extinct species.

Species change over time. Biological change over time is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life and (4) natural selection. The consequences of change over time provide a scientific explanation for the fossil record of ancient life forms and for the striking molecular similarities observed among the diverse species of living organisms. Changes in DNA (mutations) occur spontaneously at low rates. Some of these changes make no difference to the organism, whereas others can change cells and organisms. Only mutations in germ cells have the potential to create the variation that changes an organism's future offspring.

### **Background Knowledge**

This will vary depending on which level the lesson is taught.

## **Materials Required**

For each group:

- One piece of patterned fabric
- 60 dots of paper (hole punched from construction paper) in 3 different colors – 20 of each color
- Extra paper dots of each color
- Colored pencils similar to the color of the paper dots
- Hand-out with a data table
- Graph paper
- Stop watch

## **Activities**

Have supplies already in place at the tables. Tell students that they are going to perform an experiment. Allow them time to read over the experiment and then briefly review it with them.

- Groups of 3-4
- One piece of fabric that will serve as the habitat. Start with 20 each of 3 colors of dots (starting population - total of 60). The dots will be the prey.
- One person is the “game keeper” – control the colored dots
- Two people will be the predators (hunting the prey).
- Another person will be the recorder – taking note of the number of prey of each color. Notice the data table on the worksheet and the graph paper. Colored pencils are for graphing the results.

Allow them to perform the experiment on their own, observing each group to see if they need help.

- Two predators look away as the gamekeeper lays out the fabric and scatters the 60 dots from the start bag. Instructor is the time keeper. When the instructor says start, the predators have 20 seconds to pick up as many dots as they can one at a time.
- When the instructor says stop, the group members separate out the different colored dots that are left and determine how many there are of each color.
- Simulate reproduction by adding one paper dot for each remaining dot of that color. (There are bags of extra dots for each color) Record the number of dots of each color in the table provided on the worksheet.
- Repeat the predation using the second generation of dots.
- Count the remaining dots and simulate reproduction. Record the number of dots in the third generation.
- Explain to students that they do not have to simulate reproduction as they did before, but rather they should just calculate the number of individuals that would be in the third generation beginning population.
- Now graph the results from the three generations. Use colors that are similar to the colored dots.

### **Discussion Questions:**

Each group will report their findings.

**Which, if any, colors of paper dots survived better than others in the second and third generation?** (Answers will vary depending on the color of fabric the group had, there should be fewer dots of those colors that stood out against the fabric.) (knowledge/comprehension)

**What might be the reason that predators did not select these colors as much as they did other colors?** (Some colors were better camouflaged than other colors – blended into the habitat) (comprehension)

**What effect did capturing a particular colored dot have on the numbers of that color in the following generation?** (no longer reproduces, can't pass on its genes) (analysis)

**We have demonstrated the theory of natural selection. It was developed by Charles Darwin and published in 1859. He stated that natural selection is a process by which individuals with inherited characteristics well-suited to the environment leave more offspring on average than do other individuals – hence passing on those characteristics.**

### **Extension Possibilities**

#### **Apply to Everyday Life**

**Antibiotics** – Who here has taken antibiotics when they're sick? They fight off bacteria. Some strains of bacteria are resistant to antibiotics. When a population of bacteria are exposed to an antibiotic those that are resistant are able to proliferate and pass on their genes. Next thing you know is you have a whole population of **antibiotic-resistant bacteria**. Next time you get a cold the antibiotic doesn't work because they are resistant to that drug.

One way in which this happens is when doctors over-prescribe antibiotics. A virus is making them sick but they are prescribed antibiotics, what bacteria they do have could be resistant to antibiotics and given the opportunity to proliferate. Another factor is the mass production and administration of antibiotics to cattle. The antibiotics filter from the feed into the ground to the water supply where they are exposed to numerous types of bacteria. Those bacteria that are resistant to the antibiotics can then reproduce and possibly infect humans and animals.

**Endangered species** – Such as the cheetah, has anybody seen the cheetahs at the zoo – the cats that are really fast? Cheetahs were hunted so extensively that their population dwindled to just a few dozen. These few dozen interbred and now have a

very small gene pool. They are lacking the diversity necessary to overcome new diseases or other circumstances they are exposed to.

### Writing Assignment

Answer the following question in approximately one paragraph to be turned in next time: **What does the theory of natural selection mean to you?** Provide a definition of the concept in your own words (1-2 sentences). Provide an example of natural selection (other than the one presented - antibiotic-resistant bacteria) (~2 sentences). This example could be real or fictitious (made up) as long as it shows natural selection. Comment on why it is important to understand this concept for the benefit of understanding other ideas in science/biology (1-2 sentences). This assignment is worth a total of 12 points and credit will be distributed as shown in the below rubric. (synthesis)

	Understands fully/ explained clearly (4 pts)	Understands somewhat/ explained well (3 pts)	Somewhat understands/ explained sufficiently (2 pts)	Somewhat misunderstands/ explanation deficient (1 pt)
Definition				
Example				
Benefit				

### Evolution of Sickle Cell Anemia Video

This video clip is from a PBS NOVA special on evolution. It highlights sickle cell anemia and malaria as one example of pre-adaptation and evolution.

[http://www.pbs.org/wgbh/evolution/library/01/2/1\\_012\\_02.html](http://www.pbs.org/wgbh/evolution/library/01/2/1_012_02.html) or

<http://youtube.com/watch?v=IfN7rOwDyMQ>

### Corresponding Evolution Activities

#### BSCS

<http://www.nap.edu/readingroom/books/evolution98/evol6.html>

Includes lessons on Investigating Common Descent: Formulating Explanations and Models, Proposing Explanations for Fossil Footprints, Understanding Earth's Changes Over Time, Proposing the Theory of Biological Evolution: Historical Perspective, and Connecting Population Growth and Biological Evolution.

## **PBS**

<http://www.pbs.org/wgbh/evolution/index.html>

Lessons with corresponding videos on various aspects of evolution including: Darwin, change, extinction, survival, sex, and humans.