High School Science Virtual Learning

Applied Biological Science

Natural Selection

April 15, 2020

High School Applied Biological Science
Lesson: April 15th, 2020

Objective/Learning Target:

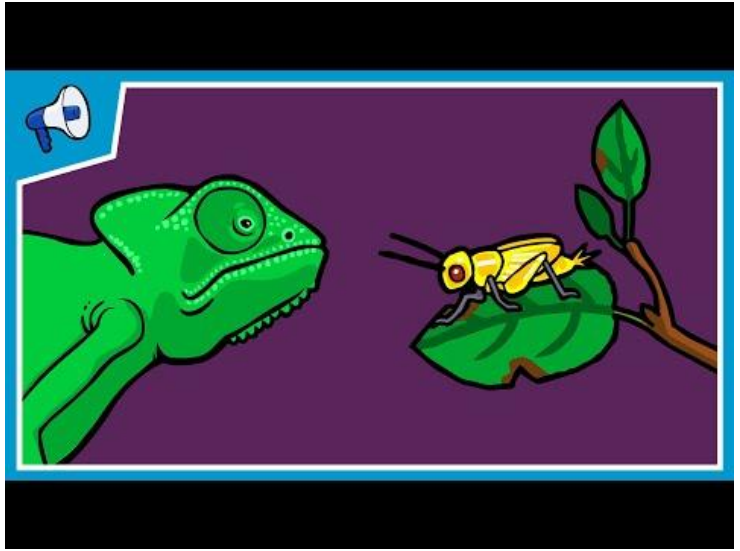
Students will be able to define and apply concepts of natural selection to life and microbiology.

Let's Get Started:

Instructions:
Watch the video then answer the questions.

1. What is common descent?

2. What is natural selection?



Let's Get Started: Answers

1. The idea that all life on Earth is related. They descended from a common ancestor.

2. The process by which random evolutionary changes are selected for by nature in a consistent, orderly, non-random way.

Lesson Activity:

Directions: Follow the link to video over natural selection in humans then answer the following questions.

Link(s): Natural Selection in Humans

Practice

You will use the video to answer the following questions.

Practice Questions

1. Consider the statement: “Sickle cell disease is a(n) _____ disease.” Which of the following terms could fill in the blank to make the statement true? There may be more than one correct answer.
   a. Genetic
   b. Infectious
   c. Potentially lethal
   d. Inherited
2. Consider the statement: “Malaria is a(n) _____ disease.” Which of the following terms could fill in the blank to make the statement true? There may be more than one correct answer.
   a. Genetic
   b. Infectious
   c. Potentially lethal
   d. Inherited

Practice Questions

3. At the beginning of the film, you were introduced to Davaun and Skyy Cooper, who both have sickle cell disease. Which of the following must be true about their parents?
   a. One parent has at least one copy of the sickle cell allele.
   b. Both parents have at least one copy of the sickle cell allele.
   c. Both parents have sickle cell disease.
   d. One parent has sickle cell disease.
4. There are now several effective antimalarial drugs that can treat people who have malaria or prevent them from getting the disease altogether. Predict what will happen to the frequency of the sickle cell allele as these drugs become more widely used. Support your answer with at least one piece of evidence from the film.

Practice Questions

5. Due to climate change, the range of malaria is expected to spread to areas where it was previously not a problem. Given this piece of evidence, predict what will happen to the frequency of the sickle cell allele in areas where malaria is introduced.

6. Is the following statement true or false? “Malaria caused the sickle cell allele to appear.” Justify your answer in one or two sentences.

Answer Key

Once you have completed the practice questions check with the work.

1. a - Genetic, c - Potentially lethal, d - Inherited
2. b - Infectious, c - Potentially lethal
3. b. Both parents have at least one copy of the sickle cell allele.
4. As malaria becomes less deadly, selection for a genetic mutation that protects individuals from the disease decreases. As a result, the frequency of the sickle cell allele will likely decrease.
5. Because the sickle cell allele provides some resistance to malaria, the frequency of the allele should increase if the prevalence of malaria increases.
6. False; the sickle cell allele arose randomly. Malaria provided the selective pressure for the allele to increase in frequency in some populations.

More Practice: Is it Natural Selection?

1. For each of the following scenarios, use this checklist to decide if it is natural selection or not.

Natural Selection Checklist

Change over time

- Has the frequency of the trait in the population changed over time?
  - Yes or No
- Evidence:

Variability

- Does the trait vary among individuals in the population?
  - Yes or No
- Evidence:

Heritability

- Is the trait influenced by genes that pass from parents to offspring?
  - Yes or No
- Evidence:

Reproductive advantage

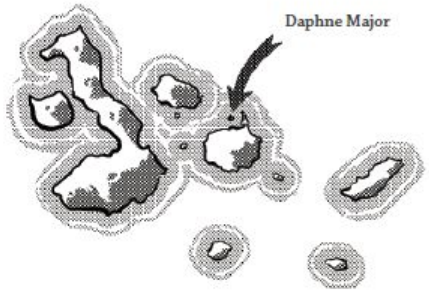
- Are individuals with a certain trait variation more successful at reproducing than others?
  - Yes or No
- Evidence:

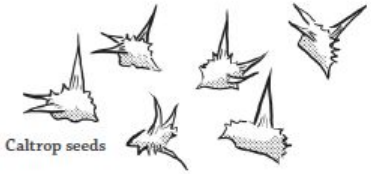
Is this an example of natural selection? (Are all three ingredients present?) Yes or No

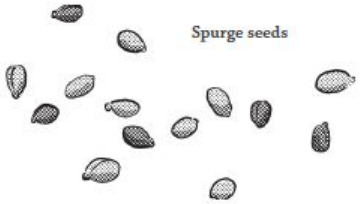
Darwin's Finches

Background

The Galapagos Islands are a group of small volcanic islands located near the Equator in the Pacific Ocean. The islands are home to several finch species, together know as Darwin's Finches. The finches on the island Daphne Major caught the interest of two scientists, Peter and Rosemary Grant, who studied the population for twenty years.



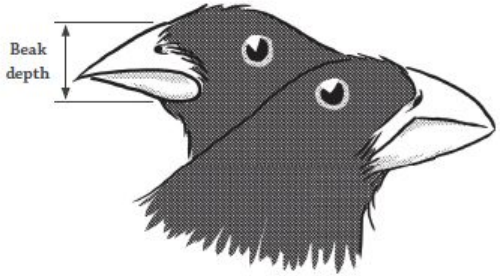




Daphne Major is a very small island with no trees and very few plant species. The scientists were able to follow all the finches on the island and record their individual feeding habits. In the dry season, the finches ate the hard woody seeds of caltrop plants and the smaller seeds of spurge plants. The scientists noticed that finches with smaller beaks struggled to crack open the hard caltrop seeds and often gave up. Beak depth was an important trait for getting food.

Experiment 1

Scientists wondered if beak depth was a heritable trait. To find out, they measured beak depths of parents and their offspring. The data are in the table on the next page.



Checklist Item	Yes or No	Evidence
Change over time		
Variability		
Heritability		
Reproductive Advantage		
Natural Selection?		

Darwin's Finches Key

Checklist item	Yes or no?	Evidence and notes
Change over time	Yes	Mean beak depth was greater in the offspring that were born after the drought.
Variability	Yes	Individuals have different beak depths.
Heritability	Yes	Beak depth in offspring resembles (has a positive relationship to) that of the parents.
Reproductive Advantage	Yes (inferred)	Individuals with greater beak depth survived, presumably because they were able to eat larger seeds. Therefore, they were more likely to reproduce.
Is it natural selection?	**Yes**	

Freshwater Snails

Checklist Item	Yes or No	Evidence
Change over time		
Variability		
Heritability		
Reproductive Advantage		
Natural Selection?		

Freshwater Snails

Background

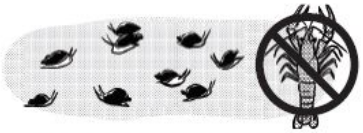
The small freshwater snail, *Physella virgata*, lives in streams. Crayfish live in some of these streams, and they eat the snails. Most of the time, crayfish eat the smaller snails.

Experiment 1

Scientists measured the shells of snails living in streams with and without crayfish. They found that the snails were larger in the streams with crayfish.

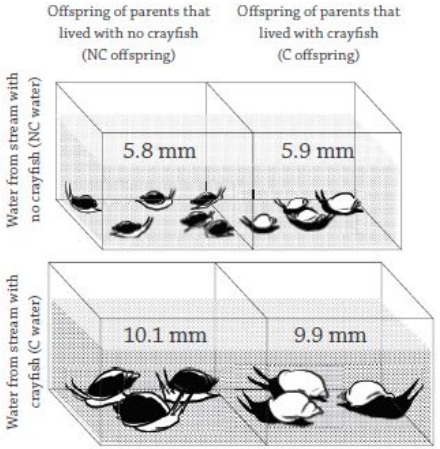
They wondered whether natural selection was causing the differences in shell length.

Snails living in streams without crayfish are smaller than snails living in streams with crayfish.



No Crayfish (NC): Mean shell length = 5.6 mm

Crayfish (C): Mean shell length = 9.8 mm



Experiment 2

To test whether shell length is heritable, scientists collected snails from two streams: one with crayfish and one without crayfish. Keeping the snail populations separate, they brought them to the lab, let them mate, and then raised their offspring in 2 different types of water:

- Half of the offspring from each group were grown in water from a stream that had no crayfish.
- The other half were grown in water from a stream that had crayfish.

After the offspring grew to adulthood, the researchers measured their shell lengths and calculated the mean for each group.

Freshwater Snails Key

Checklist item	Yes or no?	Evidence and notes
Change over time	No	In this example, we see no evidence.
Variability	Yes	Individuals have different shell lengths.
Heritability	No	Longer shell length is associated with presence of crayfish in the water, not with the shell length of the parents.
Reproductive Advantage	Yes	When they are present, crayfish eat the smaller snails, making the larger snails more likely to reproduce.
Is it natural selection?	**No**	

Additional Practice

Reproductive Advantage