

## Natural Selection

### Pressure to Adapt

Objectives:

1. Students will be able to explain how natural selection occurs over several generations of a population.
2. Students will be able to identify examples of environmental stressors that cause populations to adapt.
3. Students will understand how natural selection relates to evolution.

### Adaptations and Natural Selection

Think of a “prey animal”—an animal that is near the bottom of the food chain. Prey animals have accumulated several **adaptations** over many, many generations that help them to avoid predation and survive. Adaptations are advantageous traits possessed by a group of organisms. One well-known prey animal is the rabbit. What adaptations does a rabbit possess? Large ears helps it to hear predators and diffuse body heat, powerful hind legs allows it to bound out of reach of predators, and its nose-twitching behavior heightens its sense of smell. While rabbits are still frequently preyed, this collection of adaptations has evolved over hundreds of thousands of years. In fact, the order *Lagomorpha* (which rabbits belong to) is seen in the fossil record stretching back to 23 million years ago!

You may be wondering how these animals gain these adaptations; they certainly don't wake up one morning with longer ears or a better camouflaged color. These changes start as DNA mutations within an animal's genome. If the mutation is within a portion of the DNA that codes for a trait, a mutant phenotype could result. If this mutant phenotype is advantageous, like a body color that better camouflages the animal within its habitat, it will probably survive and reproduce. This trait, which started off as a DNA mutation, can be passed down to the next generation. In order for a mutation to become widespread within a population, the trait has to be *selected* over many generations. This process is known as **natural selection**.

Think back to the DNA mutation that causes a trait. Not all mutations are beneficial! For example, a mouse with mutations in both copies of its *Pax6* gene may be born with no eyes. If this eye-less mouse survives to adult-hood, a predator would almost certainly eat it before it has a chance to reproduce. This is a good example of how natural selection works in nature: mutations that debilitate an organism “select” against it, and the animal is usually unable to reproduce. On the other hand, organisms that are randomly born with useful mutations have a better chance of surviving and sending its genetic material into the next generation. Over time, new species are formed. This was the basis of Charles Darwin's theory of natural selection after he visited the Galapagos Islands.

*What are we doing in today's lab?* You will complete two activities. The first involves a predator (you) “eating” prey (beans). After a few generations of the bean population, you will be asked to think about how their traits—color—influenced their survival. The second activity is an owl pellet dissection, in which you will be able to see

evidence of how many and what type of prey an owl consumed. You will be asked to think about how predators can influence or shape the traits of their prey.

### Procedure for today's lab

Students may work in pairs today. Each GROUP should start with:

- a timer
- a beaker
- 20 beans of each of the 5 types (100 beans total)
- a carpet square
- one sterilized owl pellet for EACH person
- tweezers and probe for EACH person
- dissection tray for EACH person

### Activity 1 – Adaptations of Prey

1) One person will randomly distribute the 100 beans over a piece of carpet. The partner should not watch this. The beans represent different prey animals in a habitat. The partner will act as a predator and gather as many prey as possible in a **30 second** period. **PICK UP ONE BEAN AT A TIME.** The beaker serves as a collection area for the beans that are “predated,” but make sure it remains on the bench top—we don’t want any predators to have an extra advantage!

2) Record your data below. Answer the following questions before proceeding.

Color of Bean	# Dispersed	# Collected	% Collected
Red			
White			
White with black spot			
Black			
“Camo”			

2a) Which color individuals appear to be most “adapted” to this environment?

2b) What is the adaptation? How does this adaptation specifically help the individuals?

2c) What are some adaptations you know of (besides color) that different animals have developed to avoid predation?

3) Continue for a second generation: each individual that survived (still on the carpet square) is able to reproduce itself once. For each bean left on the carpet, add one more bean of the same color to the carpet. You will probably need to get more beans from the TA.

*Empty your beaker and set the beans from Step 1 aside; you don't want to mix them up with your second generation count.*

4) Record your results for the second generation below. Answer the question before proceeding.

Color of Bean	# Dispersed	# Collected	% Collected	# Remaining	% Remaining (of original 20)
Red					
White					
White with black spot					
Black					
"Camo"					

4a) Which color individuals have the best chance for long-term survival? Why?

5) Empty your beaker and clear off the carpet square. Have one person randomly disperse 5 beans of each of the 5 colors across the carpet square. Make sure the partner is not looking. This time, the predator will gather as many beans as possible in only **15 seconds**.

6) Record your results for below. Answer the following question.

Color of Bean	# Dispersed	# Collected	% Collected
Red			
White			
White with black spot			
Black			
“Camo”			

6a) What do your results imply about the number of individuals in a population and their survival? What about the survival of a species?

7) Before proceeding to the owl pellet activity, carefully **sort your beans by color** and replace them in the containers at the front of the room.

### Activity 2 – Predatory Influence on Prey

Owl pellets are made of the bone and fur of the animals eaten by an owl. When an owl swallows its prey whole, it first goes to an organ called the crop or gizzard. The nutritious portion moves down into the bird’s stomach, but the indigestible portion is coughed up as a pellet.

1) Unwrap the foil surrounding your owl pellet. *All owl pellets have been sterilized.* If you wish to wear gloves, tell your TA. Use your tweezers and probe to gently pull apart the pellet, but know that some pellets are firmer than others and may require a little more effort. Keep the fur and bone fragments together in your dissection dish.

2) After you are sure that you have extracted all of the bones from your pellet, discard the fur. You are now ready to begin sorting the bones by species or shape. Use the picture key provided by your TA. If you are unsure of how to group a particular bone, ask for help.

### Activity 2 Questions

1. How many skulls did you find total? How many different kinds of skull did you find?

