

Reading Selection: How do species change over time?

1. Who first studied how species change over time?

Jean-Baptiste Lamarck (1744-1829) and Charles Darwin (1809-1882) both had ideas about how life on earth got to be the way it is now. Some of their ideas were similar and some were very different.

2. What did Darwin and Lamarck think?

In the 1800s, when Darwin and Lamarck were alive, most people did not think that species changed at all. Many people believed that the way an organism was right then was an example of how that species had always been, and the way that species would always be.

Darwin and Lamarck disagreed with that idea. Both of them thought that living things on this planet had changed gradually over time, were still changing, and would keep changing. They also both thought that living things change so that they have a better chance of surviving in their environment, but they disagreed on how that change happened. Lamarck called his theory, the theory of **Acquired Characteristics**. Darwin called his idea **Natural Selection**.

Lamarck said that the animals were **selecting themselves** to survive. Species never went extinct; they just kept changing. Darwin said that nature exerted the pressure on a population to change, and then **nature selected** those with the best traits to survive. He believed that populations of organisms could become extinct if they were not well enough adapted to their environment.

3. What is Lamarck's theory of Acquired Characteristics?

Lamarck put forth the theory of **Acquired Characteristics**. He said that if an individual *wanted* to change something about the way its body worked, it could. When that individual reproduced, the changes that it had made during its lifetime would be passed on to its offspring.

For example, Lamarck believed that elephants all used to have short trunks. When there was no food or water that they could reach with their short trunks, they had to do something in order to survive. He believed that they stretched out their trunks a little bit, and were able to reach more water and food. When they had babies, he said that they were born with their trunks already stretched out a little longer. When this next generation needed to reach food and water that was even farther away, they stretched their trunks even farther. When they had their own babies, they were born with these even longer trunks. Eventually, all elephants were born with long trunks.

4. What is Darwin's theory of Natural Selection?

Darwin said that the fact that an individual changes something about its body or its behavior during its lifetime doesn't mean that change can or will be passed on to their offspring. Darwin said that organisms only pass down the traits that they themselves were born with. He said that individual organisms, even of the same species, are all just a little bit different from each other. For example, each person is just a little different from every other person. We have different eye colors, hairlines, and earlobes, but we are all still people. He called this **variation** within a **population or species**.

Darwin said the reason that populations changed over time was because of the pre-existing variation within the population. Certain variations made some organisms better suited to their environment than others. Since the ones that are better adapted had a survival advantage, they also lived longer, and were able to reproduce more. Every time they reproduced they passed their successful traits down to their offspring. We know today that it was the genetic makeup of entire populations that changed over time, but there was no change within each organism.

For example, Darwin would have said that a very long time ago most elephants had short trunks, but because of variation with elephants, a few of them had longer trunks. During times when food or water resources were inaccessible to elephants with short trunks, those animals with short trunks died off. They could not get enough food or water. The ones with longer trunks were able to get food and water, so they lived and went on to reproduce. Eventually, all of the elephants in the population had longer trunks. He called this process Natural Selection. It means that nature does the selecting, either for or against a certain trait or behavior.

5. Why do so many scientists believe Darwin was right?

Darwin's theory of Natural Selection has been supported by a lot of evidence. Lamarck's theory has been disproved. This was done in two ways— observations and new information about genetics.

Proof from Observation

Scientists have examined fossil evidence as well as living animals and found that their research doesn't support Lamarck's theory. Some things they have observed are:

- Physical injuries are not passed on to children.
- If a person is very good at chess, it doesn't mean that their children will be very good at chess. Their children will have to learn how to play, just like their parent did. Some will be good players through practice, while others will never master the game or acquire the skills to play.
- Fossils show evidence of entire populations becoming extinct. In Lamarck's theory, organisms would never become extinct. They would just change themselves into something else.

Proof from Genetics

The other evidence that proves Lamarck's theory wrong is the evidence provided by the study of genetics. Darwin knew that characteristics are passed on from parents to their children, but he never understood exactly how that happened. Today we know how through the study of genetics.

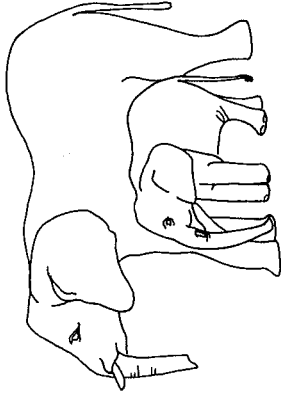
Your whole body is made up of trillions of cells. Each cell is so small that you can't see it without a microscope. Cells are composed of even smaller structures. Chromosomes are some of those very tiny structures inside of your cells. Chromosomes are made up of even smaller parts called genes.

Your genes make you who you are. They are the code that runs your body, much like the codes that run computers. Genes determine whether your hair grows straight or curly, or whether your ears stick out or lie flat. If you have children, you will pass one half of your genes on to them. The other one half of their genes will come from their other parent. Then, your children have their own set of genes, a mix of genes from both parents.

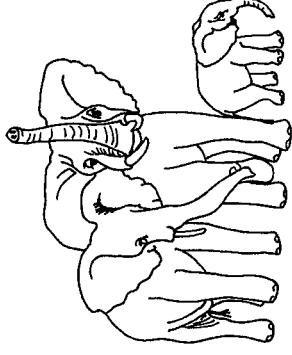
If you think about the elephants again, Lamarck said that the elephants stretched out their trunks and passed on those stretched out trunks to their babies. Now, we know this is not possible. The stretched out trunk is not part of their genes, and their genes are what they pass on to their babies.

Activity Sheet 3: Lamarck's Theory

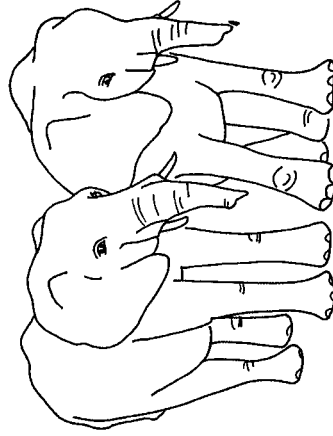
Baby elephants are born with stretched trunks .



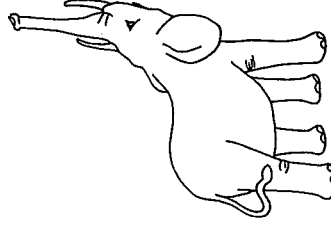
Elephants continue to stretch their trunks and have babies with even longer trunks



All elephants have short trunks

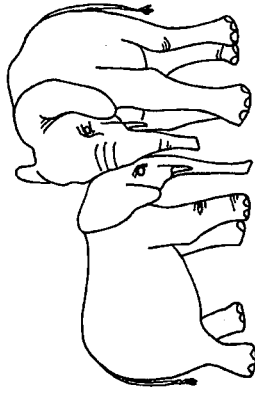


All elephants stretch their trunks a little.

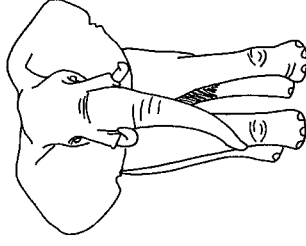


Activity Sheet 5: Darwin's Theory

Most elephants have short trunks, but some elephants have long trunks



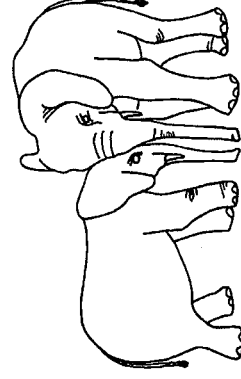
All the elephants that survive have long trunks.



Short-trunked elephants begin to die off because they can't reach food and water.



Living elephants with long trunks have babies with long trunks.



Activity Sheet 1: Compare the theories!

Name _____ Date _____

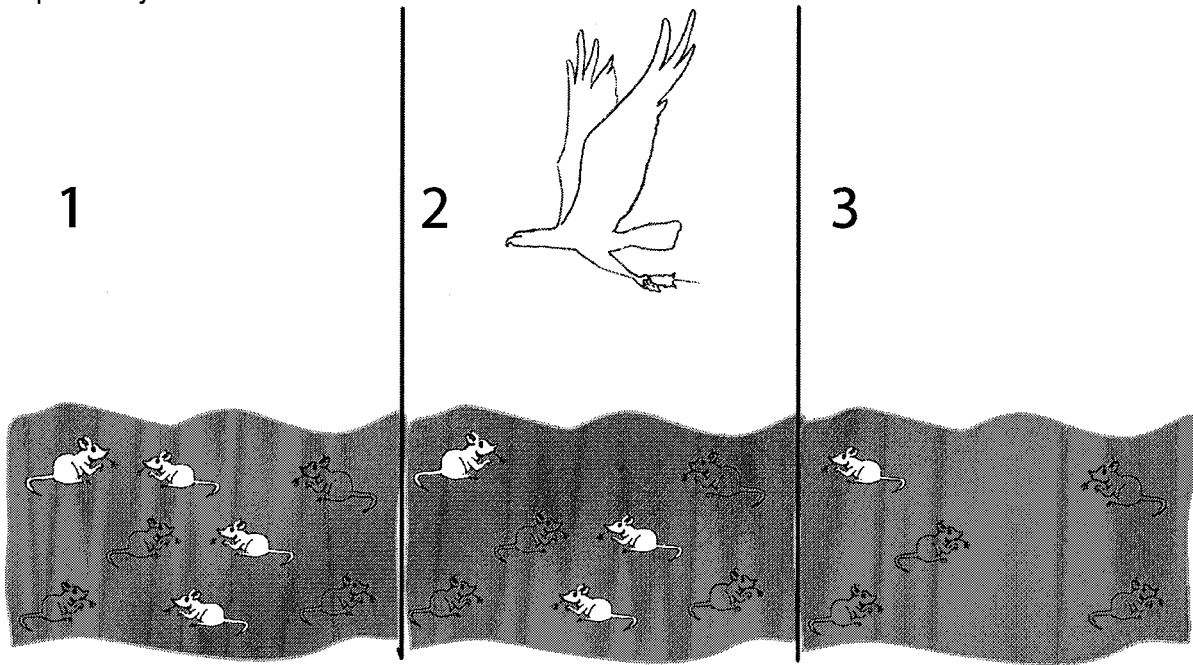
Topic		Who thought this? Lamarck, Darwin, or both of them?
1.	Organisms have changed over time.	
2.	Organisms changed because they wanted to survive.	
3.	There was variation in a population.	
4.	Certain traits helped organisms survive and reproduce better than other organisms without those traits.	
5.	Organisms can never become extinct.	
6.	The environment had something to do with why organisms changed.	
7.	Parents are able to pass on at least some of their traits to their offspring.	
8.	Parents are only able to pass on traits that they were born with.	
9.	Organisms could decide to change something about their body and pass on that change to their offspring.	
10.	Organisms are still changing.	

Name: _____ Date: _____ Period: _____

Evolution by Natural Selection

Adapted from the University of California, Los Angeles Life Sciences 1 Demonstration Manual
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Describe what is happening in figures 1-3. Is the population of mice different in figure 3 than in figure 1? Explain why.



Describe what is happening in figures 1-3.

Is the population of mice different in figure 3 than in figure 1? Explain why.

¹ Teachers are encouraged to copy this student handout for classroom use. A Word file (which can be used to prepare a modified version if desired), Teacher Preparation Notes, comments, and the complete list of our hands-on activities are available at http://serendip.brynmawr.edu/sci_edu/waldron/.

Living things that are well adapted to their environment survive and reproduce. Those that are not well adapted don't survive and reproduce. An **adaptation** is any characteristic that increases **fitness**, which is defined as the ability to survive and reproduce. What characteristic of the mice is an adaptation that increased their fitness?

The table below gives descriptions of four female mice that live in a beach area which is mostly tan sand with scattered plants. According to the definition given for fitness, which mouse would biologists consider the fittest? Explain why this mouse would be the fittest.

Color of fur	Black	Tan	Tan and Black	Cream
Age at death	2 months	8 months	4 months	2 months
# pups produced by each female	0	11	3	0
Running speed	8 cm/sec.	6 cm/sec.	7 cm/sec.	5 cm/sec.

If a mouse's fur color is generally similar to its mother's color, what color fur would be most common among the pups?

A characteristic which is influenced by genes and passed from parents to offspring is called **heritable**. Over many generations heritable adaptive characteristics become more common in a population. This process is called **evolution by natural selection**. Evolution by natural selection takes place over many, many generations.

Evolution by natural selection leads to adaptation within a population. The term evolution by natural selection does not refer to individuals changing, only to changes in the frequency of adaptive characteristics in the population as a whole. For example, for the mice that lived in the beach area with tan sand, none of the mice had a change in the color of their fur; however, due to natural selection, tan fur was more common for the pups than for the mother mice.

In summary, a heritable characteristic that helps an animal or plant to have more offspring which survive to reproduce will tend to become more common in a population as a result of evolution by natural selection.

Questions

1. Explain why a characteristic which helps an animal to live longer will generally tend to become more common in the population as a result of evolution by natural selection.
