

# **Apples and the Science of Genetic Selection**

# Independent Learning Lesson: Apples and the Science of Genetic Selection

GRADES 9–12



In this lesson you will distinguish between natural and artificial selection as you learn about the science and genetics of apples.

## Activity 1: How do apple characteristics differ?

Begin by thinking about apples. What is your favorite variety of apple and why? Think of apples of all shapes, sizes, and colors as you answer the following questions:

(a) In your opinion, what characteristics make a “good” apple?

(b) In your opinion, what characteristics make a “poor” apple?

(c) How are different varieties of apples developed?

## Activity 2: Where did the apple originate?

Can you imagine life without sweet, delicious apples? In the early years of America, there was no such thing as the apple we are familiar with today. The crabapple is the only apple native to North America. Most of us have heard the story of Johnny Appleseed, a barefoot nomad who traveled across the United States randomly dispersing apple seeds, but let's read [the real story of John Chapman](#). Then answer the questions below.

(a) What are the similarities and differences between the cartoon tale of Johnny Appleseed and the real life of John Chapman?

(b) What were native apples (crabapples) used for in the 1700s and 1800s? Why?

(c) How have apples changed since then?

## Activity 3: Why aren't apple trees grown from seed?

Apples today are not the same as the native crabapples that grew hundreds of years ago. Apples have been selectively bred to produce the varieties that we know today. Apple breeders plant apple trees from seed ONLY to find and develop new traits. The apples we eat were grown on farms from trees propagated by grafting. Grafting is when a shoot or bud of one tree is inserted

into or joined to the stem, branch, or root of another tree so that the two grow together. Watch the video, [Apple – How Does it Grow?](#) and answer the following questions.

**(a)** Why don't apple farmers grow apples from seed?

**(b)** What is grafting?

**(c)** What is the genetic relationship of two apple trees produced by grafting?

#### **Activity 4: What changes apples from a solid to a liquid?**

Food processing is the transformation of foods from one form (raw) into another. Apples are made up of 85% water and 10% sugar. How do you think temperature and time can be used to create a “sauce” or liquid version of apples? The main difference between the solid and liquid phase of an apple is due to the amount of energy and the arrangement of molecules. Solids have tightly bound molecules that vibrate due to their packed nature and lower energy. Liquids have freely moving atoms and a higher energy state than solids.

**(a)** While there are thousands of varieties of apples throughout the world, [these 10 apples](#) are the most popular in the United States. What characteristics make an apple ideal for different uses?

**(b)** In addition to applesauce, what other food products can be made from apples?

## Activity 5: What makes an apple crisp?

A *cultivar* is a plant variety that has been produced by selective breeding so that it contains specific characteristics. Fruit breeding programs have developed many well-known apple cultivars. For example, the Honeycrisp apple, was introduced by the University of Minnesota in 1991. The crispness of an apple can be explained by evaluating the cells of the apple. The cells of the Honeycrisp are larger than other apples and contain large vacuoles and pockets of sugar. When you bite into the apple, the cells burst open releasing the juices inside. In other apples like the Red Delicious, the cells are smaller and do not burst open when you bite into them. Watch the video, [Have We Engineered the Perfect Apple?](#) then answer the questions below.

(a) Who is responsible for creating the Honeycrisp apple?

(b) Describe the difference between the cells in a Honeycrisp versus the cells in a Red Delicious apple.

(c) What is one drawback to the minimal genetic differences found in the apple industry?

## Activity 6: How can a specific trait be added to an apple?

*Selective breeding* is a process where specific plants or animals are paired for breeding in order to perpetuate specific phenotypic traits. Watch the video, [Natural Selection vs Artificial Selection](#).

(a) If you were developing a new variety of apple, what 3 characteristics would you want to have?

(b) List 2 criteria that must be present for artificial selection (aka: selective breeding).

## Activity 7: Natural selection vs. artificial selection

Compare and contrast natural selection and artificial selection (a.k.a. selective breeding) by completing the table below. Select whether each characteristic describes *natural selection*, *artificial selection*, or *both*.

Characteristic	Selection Type
Desired traits are selected by humans	-- Select Type -- ▾
Process that occurs naturally without human interference	-- Select Type -- ▾
Acquired traits increase the species' chance of survival	-- Select Type -- ▾
Acquired traits do not always increase the species' chance of survival	-- Select Type -- ▾
Examples: colors of the peppered moth or finch beaks	-- Select Type -- ▾
Examples: dogs, livestock, or crops	-- Select Type -- ▾
"Survival of the Fittest"	-- Select Type -- ▾
Traits are inherited from parents	-- Select Type -- ▾
Results in change in genetic traits of a species	-- Select Type -- ▾
Change occurs over many generations	-- Select Type -- ▾

### Key Points

- Apples have a long history of importance and selective breeding in the United States.
- Most apple trees today are grown through grafting, a method of asexual propagation to reduce genetic variability in apples intended for consumers to eat. This allows every apple of a specific variety to taste and look the same no matter where it was grown.
- In apples, characteristics such as color, texture, sweetness/tartness, juiciness, and crunchiness are determined by the genetic make-up of the apple.

- Scientists use a knowledge of genetics and heredity to crossbreed apples (using seed, or sexual propagation) to produce new varieties of apples.