SCIENCE: 3-5

Meets North Carolina Standard Course of Study

Pomology has its roots in apple growing.

Apple Tree Grafting

The Apple Blossom

Apple Blossom Fill in the Blanks

The Apple Tree

Experiment: How Apple Trees Get Fed

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Apple Parts

Apple Parts Fill in the Banks

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POMOLOGY HAS ITS ROOTS IN APPLE-GROWING

Pomology, or the study of apples, relies on many other sciences to provide an understanding of how fruit grows on a tree. Weather, nutrients in the soil, “tree habit” (how different kinds of apples grow on the tree) are many factors that shape what kind of apple a pomologist can grow!

Many types of professionals work in the apple orchard year-round!

Apple seedlings do not make “true” trees. This is why seedling rootstocks are bud-grafted. Bud-grafting means that a “Mother tree” which has a certain variety of apple, has some buds cut out and grown onto a new, young tree.

Apple trees can be planted at “high densities” of over 2000 trees per acre! Such plantings depend on the rootstock of the tree. Rootstock determines how big the trees will get; the yield of apples from an orchard relies on rootstock size & orchard management. Yields may average more than 2,000 bushels per acre in a high-density orchard!

Thinning is a practice carried out in the orchard. “Fruit set” can be determined by looking at how many blossoms are on the tree. Thinning fruit helps the best apples grow big & get good color.

The tree’s “productive life” averages from 6 to 40 years, depending on how the tree is cared for. Many old apple trees in America have continued to exist for over 200 years -- since the time of “Johnny Appleseed” (John Chapman, his real name, really did plant trees across the New York countryside!)

Apple-growing uses many skills which science has made better: insect & disease control, fertilization, pruning, & thinning.

Getting the apples to market is no easy task. Many people work together as a team to make this possible. Harvesting, storing, & packing apples doesn’t do any good unless there’s a market to sell them to! These things are as important as growing fresh apples!

APPLE TREE GRAFTING

Apple farmers use grafting or budding as a way of producing varieties that are the same as their parents.

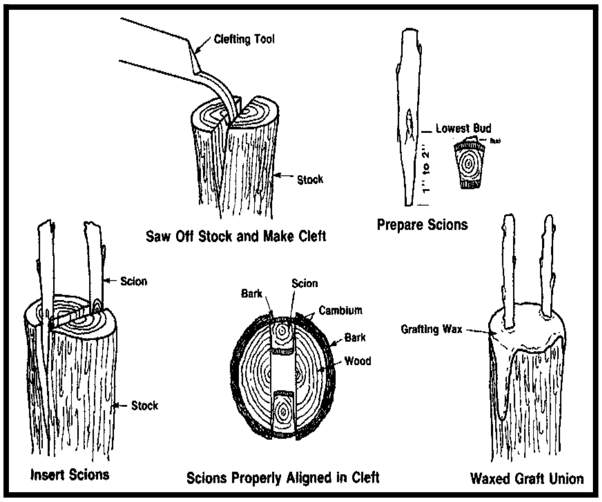
Identical apple trees cannot be grown from seed since they do not produce “true to type”. It is much like our own families. Even though brothers and sisters have the same parents they look different. Apple trees are similar. Apple trees grown from seeds may have the same parents but they are all a little different. Every apple seed produces a new variety. This is why today we have over 7,000 recorded varieties.

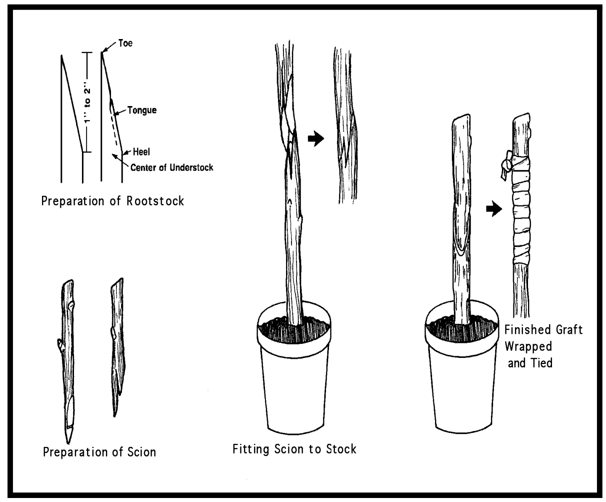
There are two kinds of grafting, cleft and whip grafting. Cleft grafting is one of the simplest methods of grafting. It is used to create new trees. It is also possible to gradually change an existing tree to grow any variety of apple tree by grafting new scions to the old tree. A slit is made during the winter or early spring. The rootstock is gently wedged open. The scion is cut to expose the parts of the branch underneath the bark that is then inserted into the cleft. The open cut is then wrapped with wax to protect if from drying out. The living tissues of the scion and new rootstock will soon combine to form a new tree. As the new tree grows, it will produce only the variety that was grafted into the rootstock

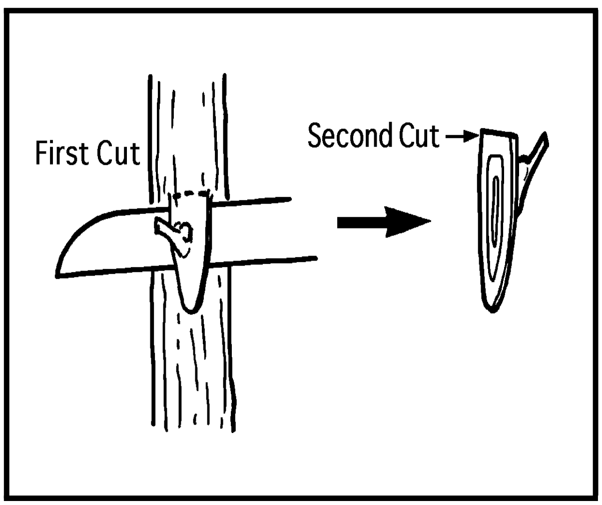
Whip grafting is done on small one-year-old trees. Rootstocks are the lower portion of a grafted plant that has or will develop the root system onto which a variety is grafted. A young branch, called a scion, is cut from the variety that you want to grow. The scion contains 3-4 buds from which branches and leaves will grow. This scion is grafted into a slit made at the top of the rootstock. The two parts are joined together, creating a new young tree. These trees are grown in nurseries for one to two years after they are budded before being transplanted by the grower to his orchard. Some growers graft their own trees by purchasing the rootstock from a nursery and grafting it over to the variety they want. Other growers will purchase the trees already grafted and ready for winter planting.

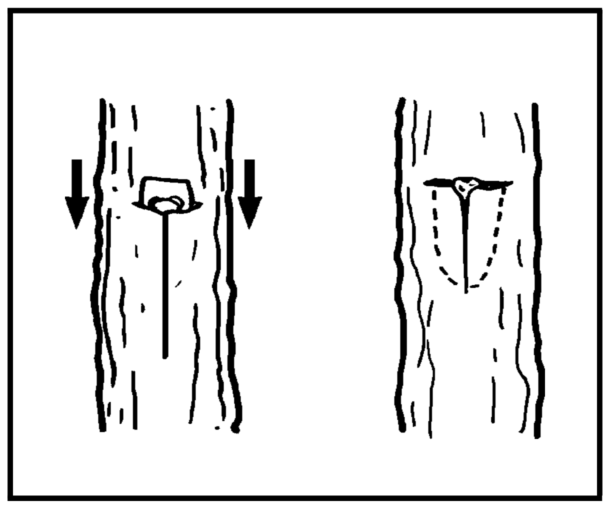
Budding is a simple process. It is done by peeling a small section of bark containing a bud of a young tree. This bud section is placed into the slender whip of a one-year-old tree where the bark has been cut and peeled back. The bud will grow onto the rootstock forming a new tree of the same variety from which the bud was taken. Grafting and budding are the most common ways of growing tress that will bear the same identical variety of apple the growers wants.

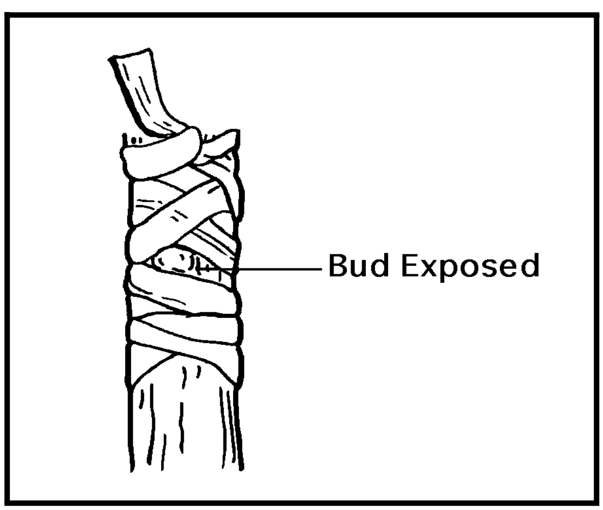
APPLE TREE GRAFTING



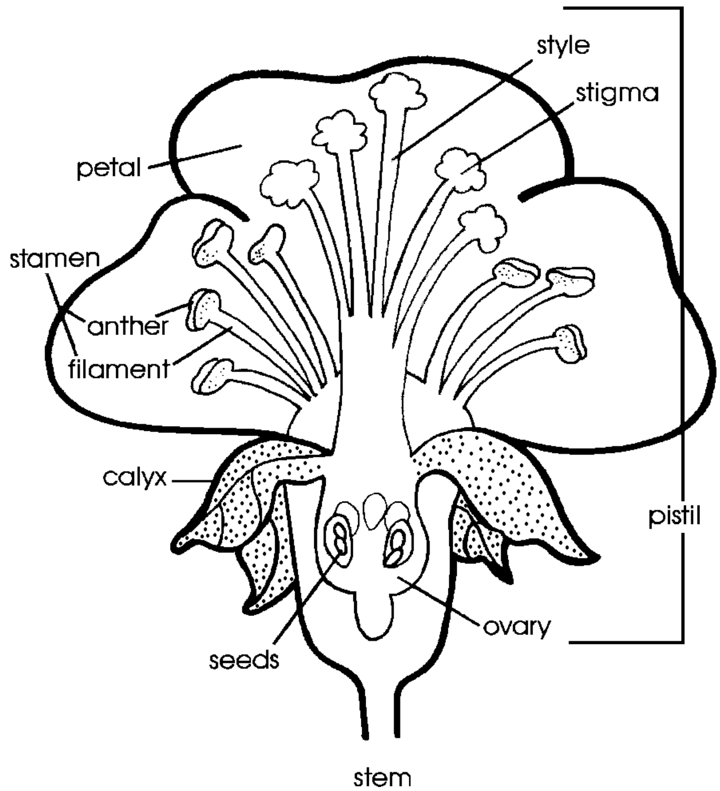








THE APPLE BLOSSOM



The flowers have many parts that are crucial to the formation of apples:

Sepals - five green, leaflike structures that make up a flower's calyx

Petals - the part of a flower that attracts insects by their color and scent

Stamens - the male reproductive part made up of an anther and filament

Anther - the part of the stamen that produces pollen

Filament - the stalk of the stamen

Pistil - female part of the flower, made up of a stigma, style, and an ovary

Stigma - the top of a flower's pistil

Style - the part of a pistil that connects the stigma and the ovary

Ovary - the rounded base of the pistil, inside of which are five compartments each containing two ovules, female reproductive cells that can become seeds

Source: US Apple Association

APPLE BLOSSOM

FILL IN THE BLANK

The flowers have many parts that are crucial to the formation of apples:

Choose words from the word list to fill in the blanks in the sentences.

ovary	**sepals**	**stamens**	**style**
petals	**calyx**	**seeds**	**stigma**

Sepals are five green, leaflike structures that make up a flower's _________.

The part of a flower that attracts insects by their color and scent is called the __________________.

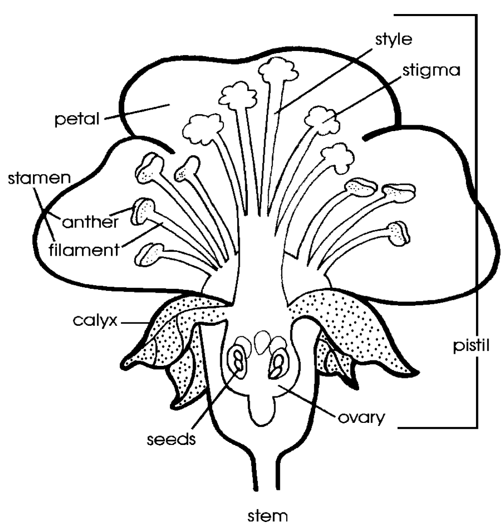
The ___________ is the male reproductive part made up of an anther and filament.

The female part of the flower, called the pistil is made up of a stigma, style, and an ____________.

__________ is the top of a flower's pistil.

The ovary is a rounded base of the pistil, inside of which are five compartments each containing two ovules, female reproductive cells that can become ________.

The __________ is the part of a pistil that connects the stigma and the ovary.

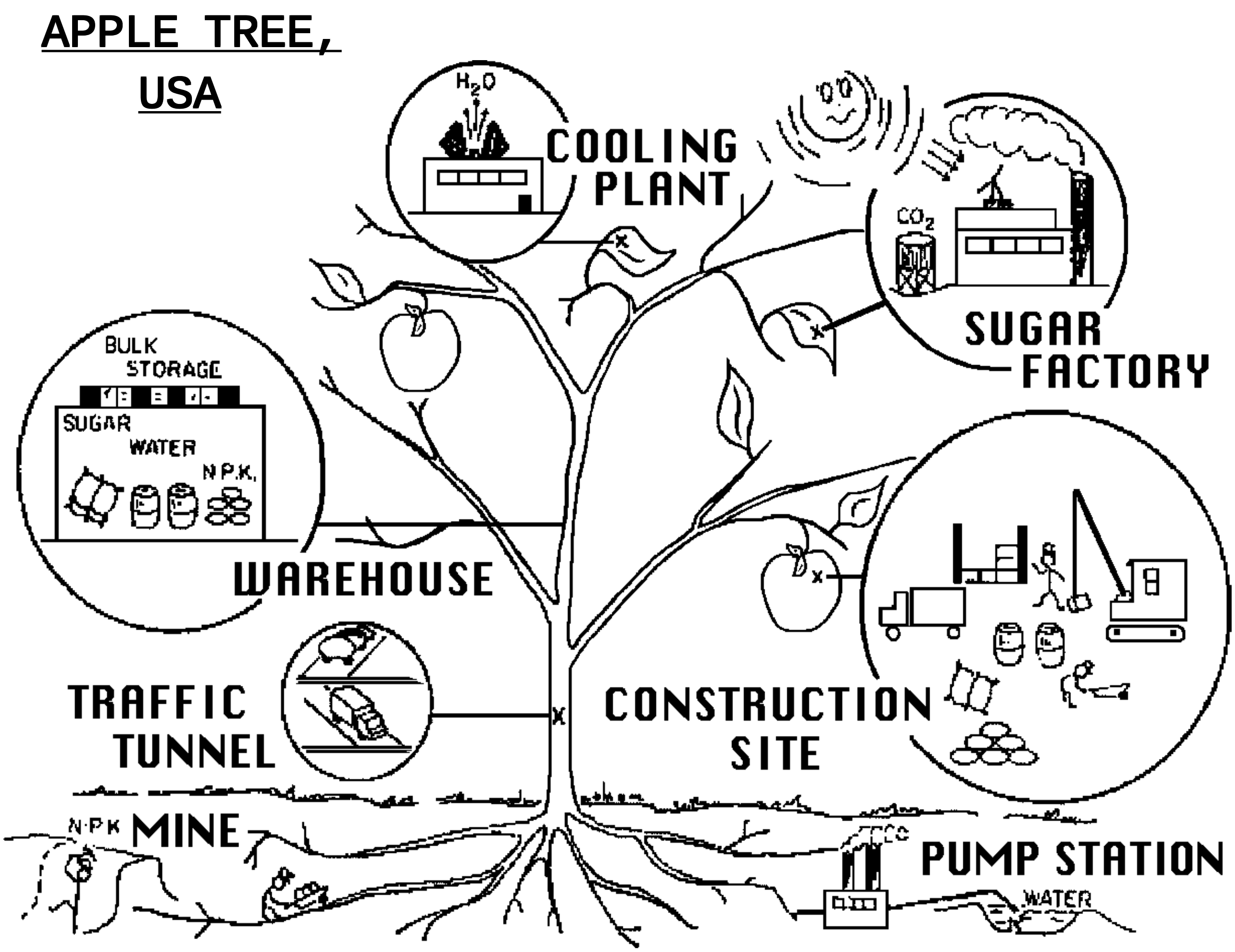


Source: US Apple Association

THE APPLE TREE

An apple tree needs water and food to grow. The tree's roots drink water from the soil which has nutrients. These are carried up to the leaves through the tree's spine, or trunk that acts like a water pipe that never cuts off. Water and nutrients from the roots travel up to the leaves through a layer of tissue in the pipeline called the xylem. Food made by leaf travels down through the pipe or tissue called the phloem to the roots. Roots not only support the tree, they store food during the winter.

The bark is a protective layer on a tree. It is very rough and cracked because it stretches as the trees grows. Bark protects the tree from hungry animals and insects that may attack the tree. The bark also keeps the tree warm in winter and cool in summer.

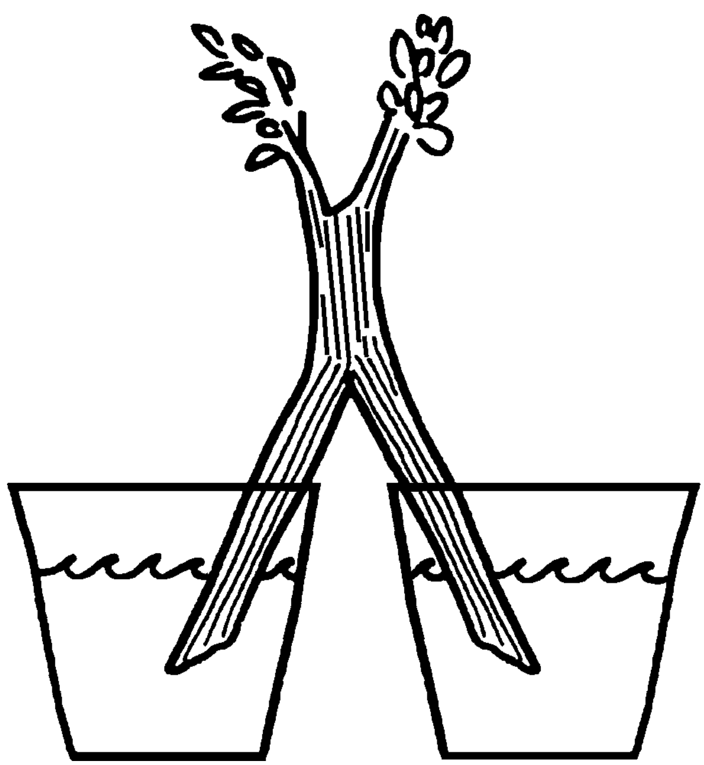


Experiment: How Apple Trees Gets Food

This experiment with celery will show how the water and nutrients flow up from the apple tree's roots to the leaves and flowers.

Materials needed: a stalk of celery
- knife
- two glasses
- food coloring - two colors
- spoon

1. Fill two glasses 1/2 full with water.
2. Put the food coloring into the two glasses, one color in each glass.
3. Trim off the end of celery with a knife.
4. Split the stalk in half lengthwise almost to the top.
5. Place one side of the stalk in one glass and the other side in the other glass.
6. Leave for 1-2 hours to see the results.
7. The color of the celery should change.



THE CELL DENSITY OF AN APPLE

SCIENCE EXPERIMENT

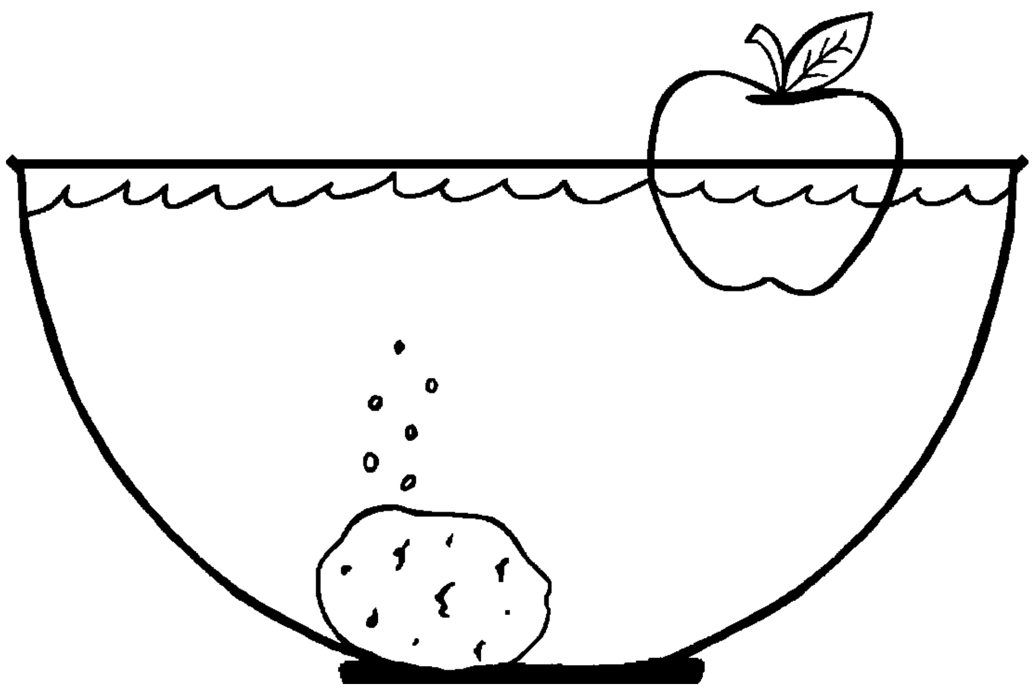
Materials:
- large bowl (filled with water)
- Irish potato
- apple

Students will guess what the potato and apple will do when placed in the bowl of water.

Put the potato and the apple in the bowl one at a time. Students should explain why the potato sinks and the apple does not.

Try with this experiment with other fruits and vegetables.

Explain to the students that foods like potato and apples vary greatly in the amount of air they contain. Potato cells are packed very tightly and are very heavy, making the potato sink. The apple cells contain more air spaces. This causes the apple to float.



SOAKING UP THE SUN'S RAYS

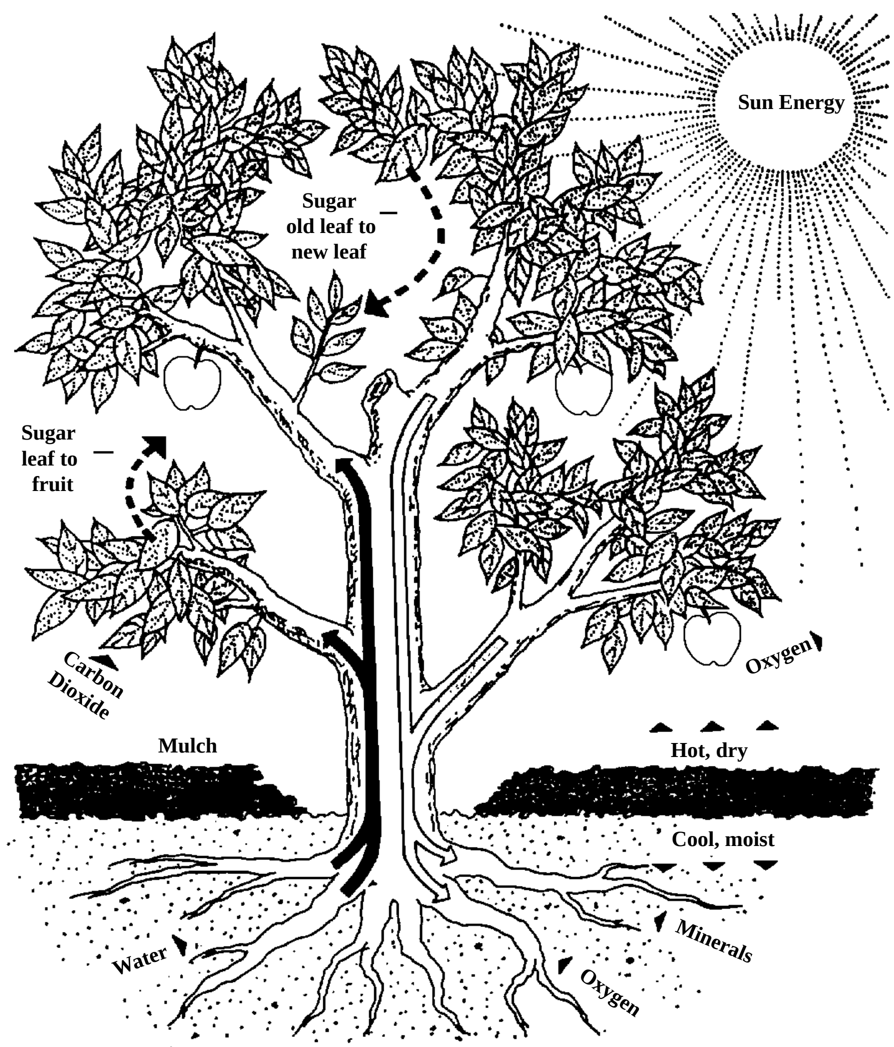
APPLE TREE LEAVES

Did you know that leaves breathe just as you do? Instead of breathing in oxygen and breathing out carbon dioxide as we do, leaves breathe in carbon dioxide and breathe out oxygen.

Inside leaves there is a chemical called chlorophyll, which gives the leaves their green color. When the sun shines on the chlorophyll, the leaf makes food in the form of sugars and starch which the tree and the apples must have to grow. This process is called photosynthesis. It takes about 40 leaves to make enough food for one apple to grow to about 3".

Activities

- **Observe an apple tree leaf through a microscope.**
- **Have students draw and describe other plants or trees whose leaves "Soak up the Sun's Rays" to survive.**



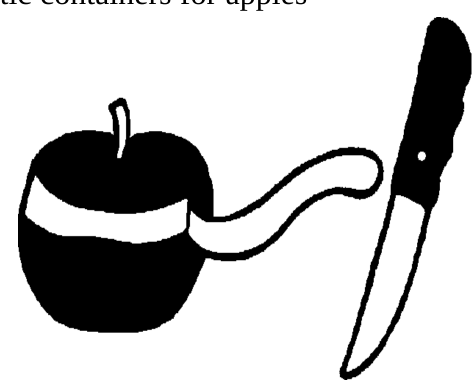
CHECKING WATER LOSS IN APPLES

During the harvest months of August through October in North Carolina, apples are picked fresh off the trees. If the apples are not stored properly once they are harvested, they will lose water by shriveling, drying up, and going bad
There are three basic ways to store apples: room temperature, cold storage, and controlled atmosphere storage.
Before starting the experiment, do the following:
-Conduct an apple survey - which of the four varieties will lose water the fastest and in what state will the apple lose the greatest amount of water.
-Gather information about water loss in apples.

The experiment will check the water loss in four varieties of North Carolina apples over a five-day period of time.
The apples will be stored at room temperature in a sunny location.
Three apples of each variety will be tested. Apple A will be whole with the skin on, Apple B will be whole with the skin removed, Apple C will be chopped into wedges with skin on.

Materials:

- 4 varieties of North Carolina apples
- 3 uniform-size apples of each variety
- apple wedge or knife
- (Checking Water Loss in Apples worksheet and graph)
- scales
- plastic containers for apples



Procedure:
Label the apples:

Apple A - whole with skin on
Apple B - whole with skin off
Apple C - chopped into wedges with skin on

1st day: Arrange apples according to variety and labels.
weigh apple A and record the weight in the worksheet and graph
weigh apple B and record the weight in the worksheet and graph
weigh apple C and record the weight in the worksheet and graph
2nd - 5th day: Weigh and record weight loss for each day.
Graph each apple’s daily weight.
5th day: Total weight loss for each apple.
Average each apple’s daily water loss.

Discuss Results and Conclusions:
Which apple lost the most water with the skin on? Which apple lost the most water with the skin removed? Which apple lost the most water if cut into wedges?
Does the skin of an apple give it protection against water loss?
Is storing apples at room temperature the best way to store apples.

CHECKING WATER LOSS IN APPLES

WORKSHEET

Record weight of each apple.

Whole apple A ______________

Peeled apple B ______________

Chopped apple C ______________

Record water losses in daily weight.

GOLDEN DELICIOUS

	A	B	C
DAY 1			
DAY 2			
DAY 3			
DAY 4			
DAY 5			

RED DELICIOUS

	A	B	C
DAY 1			
DAY 2			
DAY 3			
DAY 4			
DAY 5			

MUTSU

	A	B	C
DAY 1			
DAY 2			
DAY 3			
DAY 4			
DAY 5			

ROME BEAUTY

	A	B	C
DAY 1			
DAY 2			
DAY 3			
DAY 4			
DAY 5			

What is the average amount of water loss that apple A lost daily?

Total ______ divided by 5 = ______(average)

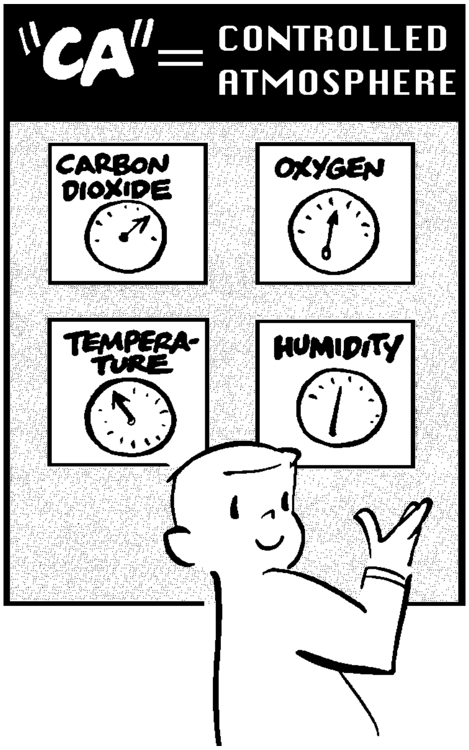
What is the average amount of moisture that apple B lost daily?

Total _____ divided by 5 = _______(average)

What is the average amount of water that apple C lost daily?

Total _____ divided by 5 = ______(average)

CONTROLLED ATMOSPHERE (CA) STORAGE AND APPLES



Just as we do, apples take in oxygen from the air to keep them alive. Apples can be stored in cold storage units to extend their life or to keep them fresh for a longer period of time, but cold air only slows down the ripening process; it doesn't completely stop it. In order to keep the fruit from getting too ripe, we must lower the oxygen content in the air where the apples are stored.

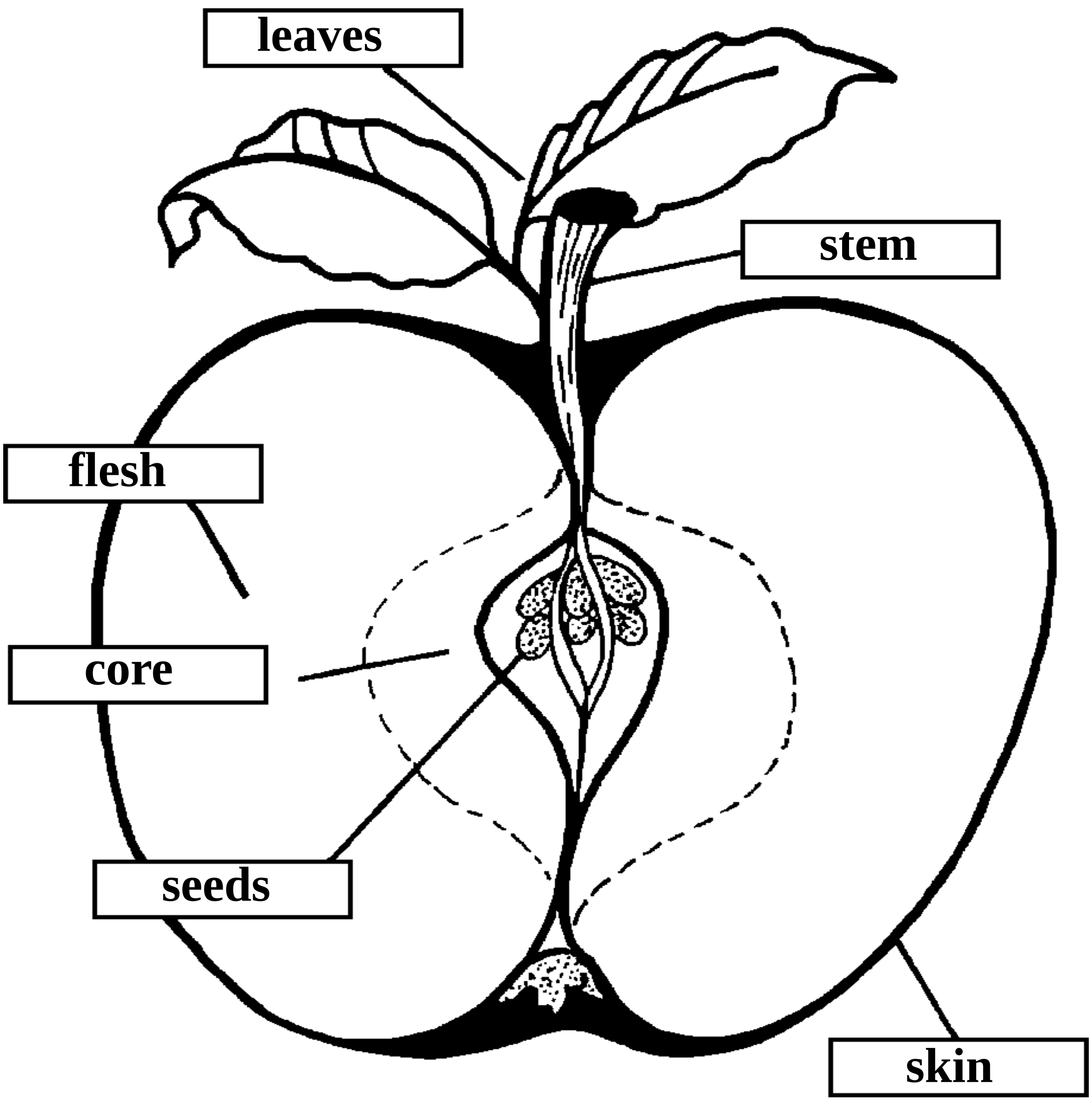
We can do this in Controlled Atmosphere (CA) Storage. Air normally contains about 20% oxygen. In CA Storage the oxygen level is dropped to 1.5% and the temperature is kept between 32-38 degrees Fahrenheit. This process puts the apple to sleep! The apple gives off carbon dioxide that keeps it from ripening any-more. The humidity in CA Storage is kept at about 95% and this keeps the fruit from losing moisture and drying out.

Even after months of "sleeping" in CA Storage, the apples can come out as crisp and fresh as they were during harvest. CA Storage has become very important to the apple industry. It allows the growers to extend the life of their fruit so they can stretch out sales through the winter months.

Source: US Apple Association

APPLE PARTS

Prepare a chart that shows the parts of an apple. Print the name of each apple part on separate cards. Have students match the word cards to the correct apple part on the chart.

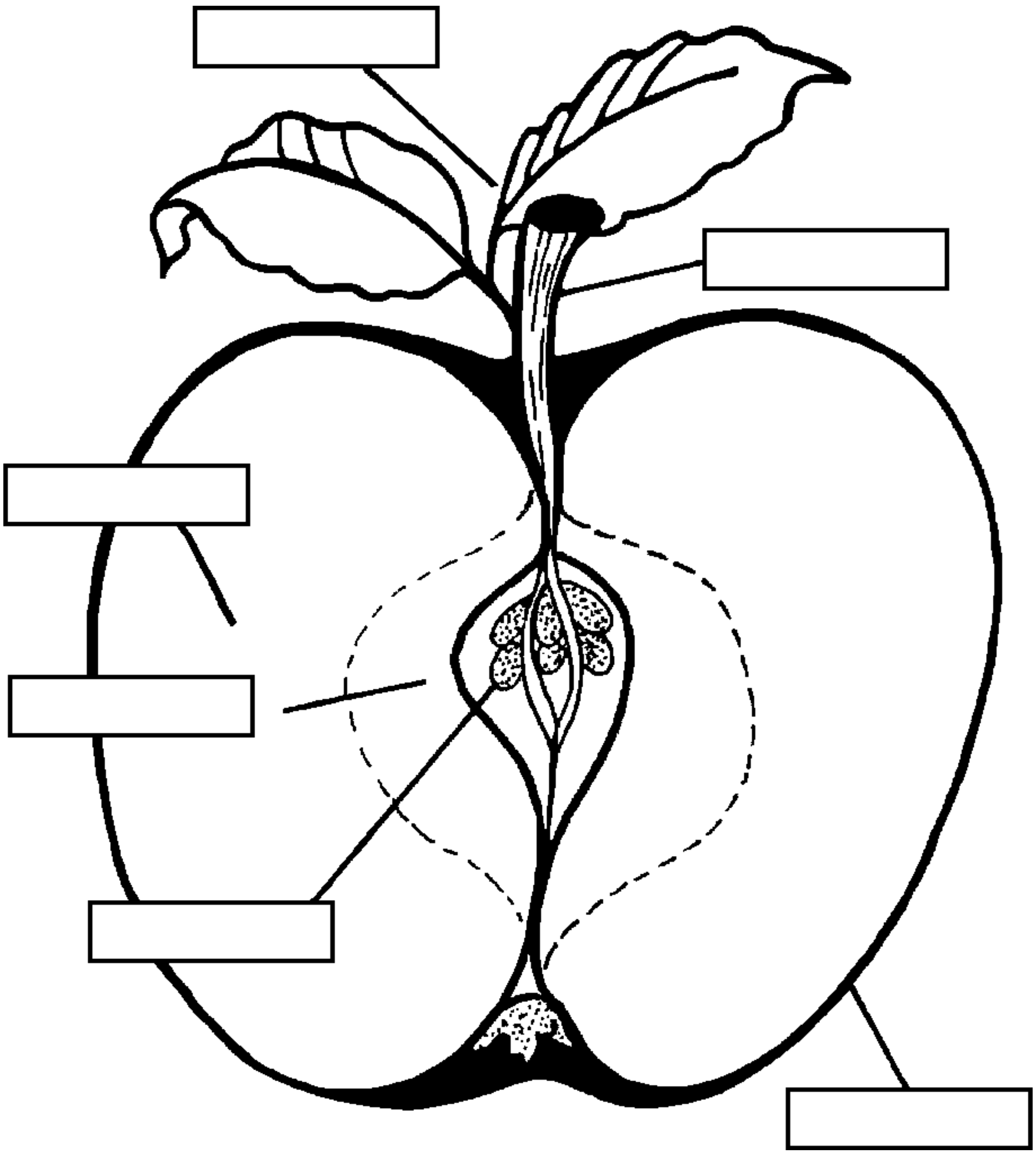


Source: US Apple Association

APPLE PARTS

Label the apple picture with the following terms:

leaves	skin	core
flesh	stem	seeds



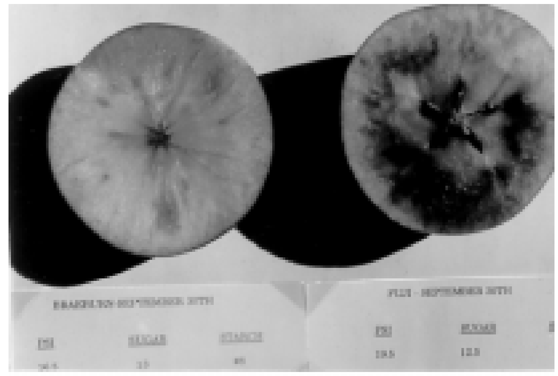
Source: US Apple Association

Seed Color Test

Activity

Another apple maturity test is the seed color test.

Test - Cut apples across the core so the seed cavities are exposed. A mature apple's seeds have turned brown. Group the seeds according to their color (no color, 1/4 brown, ½ brown, 3/4 brown, full color). The apples are not usually ready for harvesting until all seeds have turned completely brown. If possible, check apple samples from the same orchard weekly to evaluate changes and progression. Graph your results weekly.



Activity: Starch-Iodine Test

Immature apples convert sugars coming from the leaves into starch, and store this starch in cells of the growing fruit. As apples mature and ripen, the starch in immature fruit changes to sugar. The amount of starch in an apple can easily be seen by staining a freshly cut surface of the fruit with a solution of iodine. Note: testing should start about three weeks before normal harvest date depending on season and varieties.

Test - cut apples across the core so the seed cavities are exposed. Place the halves with the cut side up on newspaper or outside on the ground to prevent iodine stains. Use a spray bottle with iodine in it to spray the apple halves or dip the halves into a dish full of iodine. Let sit for 1 minute.

Watch to see the parts of the apple become a dark purple color. The purple will show up on the starchy areas. If your apple has a lot of starch, it is not fully ripe. If it has only a little, it is ready for picking. The starch has changed to sugar!

Repeat the test in 2-3 days with new fruit from the same orchard if possible.

Iodine Recipe: Dissolve one level teaspoon of potassium iodide crystals (about 10 grams) in approximately 1/8 cup water in a quart container. Gently swirl the container until crystals dissolve. Next add 1/3 teaspoon of iodine (about 2-5 grams) and swirl until iodine dissolves. Combine with water to make one quart solution. Chemicals can be purchased at your local drugstore. Caution, solution is very poisonous!

Seed Color Tests words

______ left	______ right
overmature	undermature