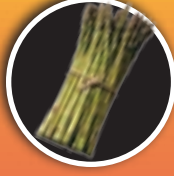
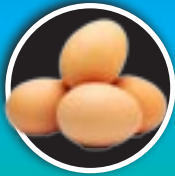




# Ag@School

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## Today's Apple A Result of Improvement Through Technology

Washington produced 54.5% of all apples grown in the US in 2010. Apples are the leading agricultural crop in the state, with a 2010 farm value of \$1,443,890,000.



Washington's nine most popular varieties were developed after years of plant selection. Advances in the science of genomics will allow scientists to design the next favorite variety more quickly and with precise selection of favorable traits.



### Today's Children... Tomorrow's Leaders

**tech•nol•o•gy** (tek nol'ə jē), n. using scientific knowledge to find a better way of doing something.



## Amazing Apples

Red, Yellow, or Green! Shiny! Crisp! Crunchy! Juicy! Sweet or Tart! Fruity Aroma! Yummy! We must be describing a fresh apple. Did you ever wonder about the amazing variety of apples at the supermarket? Scientists have determined that the ancestor to all cultivated apples can be found in Kazakhstan—along the mountainous border with China. The first apple trees in this country were planted by the pilgrims at the Massachusetts Bay Colony. Orchardists today continually improve growing methods to produce apples that are crisper, juicier, more flavorful, and keep better in storage.

## Amazing Agriculture

Farmers and ranchers rely on scientists and engineers to provide new discoveries, resulting in advancements in farming techniques for all crops, and livestock too. That is technology---using scientific knowledge to find a better way of doing a job. US agriculture is very successful at applying technology. While one US farmer could feed 19 people in 1940, today a single farmer feeds 154 people! Even more amazing, farmers and ranchers are able to do this without cultivating more land. This **high-yield agriculture** depends on increases in production based on science and technology.

## Roses & Apples Strange Relatives

The rose family (Rosaceae) includes many important crops like apples, pears, almonds, peaches, apricots, plums, cherries, strawberries, raspberries, and cut roses.

## High-Yield Agriculture



Farmers grow more food on each acre by using technology. They choose improved seeds and plants, add plant food (fertilizer) to the soil, manage pests, and use better equipment and techniques to increase production.

## Johnny Appleseed

Johnny Appleseed was a legendary American, born in Massachusetts in 1774. His real name was John Chapman, but he was called Johnny Appleseed because of his love for growing apple trees. He didn't randomly spread where he went. In apple seeds everywhere rather than around them to livestock, and left care of a neighbor shares. He owned Ohio, Pennsylvania and Indiana. Although he was successful with his trees, Appleseed lived a simple life. He was a vegetarian, wore raggedy clothes, and was a very religious man. It is said that as Johnny traveled, he wore his cooking pot on his head as a hat (this may or may not be true!).



## Seeds Are Not Always Used to Grow Plants

When a plant forms a seed, it will contain traits from both parents. That is not always desirable. If we used only seeds to get new apple trees, we would not be certain to get the same good traits as the parent tree, because pollen from another tree might have created the seed. Apple trees are propagated (multiplied) by **grafting** growing parts together. The tree nursery chooses a **rootstock**, a tree variety that will determine the height of the tree as well as other traits like hardiness in cold weather or resistance to certain plant diseases. Most rootstock varieties are dwarf trees that will only grow 8-12 feet high instead of the 20 to 30 foot tall standard tree. Dwarfing trees are desirable because they are easier to prune and pick, and also yield more apples per acre. Cuttings of small stems are taken from the mature tree and allowed to root. When the cutting is well rooted, a **scion** (a living shoot or bud) of the chosen apple variety is united with the rootstock. The resulting apple tree will grow apples like those from the scion parent and have the height and hardiness of the rootstock parent.



# TRADE IS A WASHINGTON TRADITION

Washington relies on trade to countries around the world. It is part of the **Pacific Rim** and is also situated mid-way between Asia and Europe. Thanks to our geographic location and deep water ports, we have a favorable international trade advantage. By ship, our ports are about two days closer to Asian markets than California ports. By air, the polar route (over the Arctic) brings Europe as close as Asia. Agriculture and food exports account for about 23% of total exports from Washington.

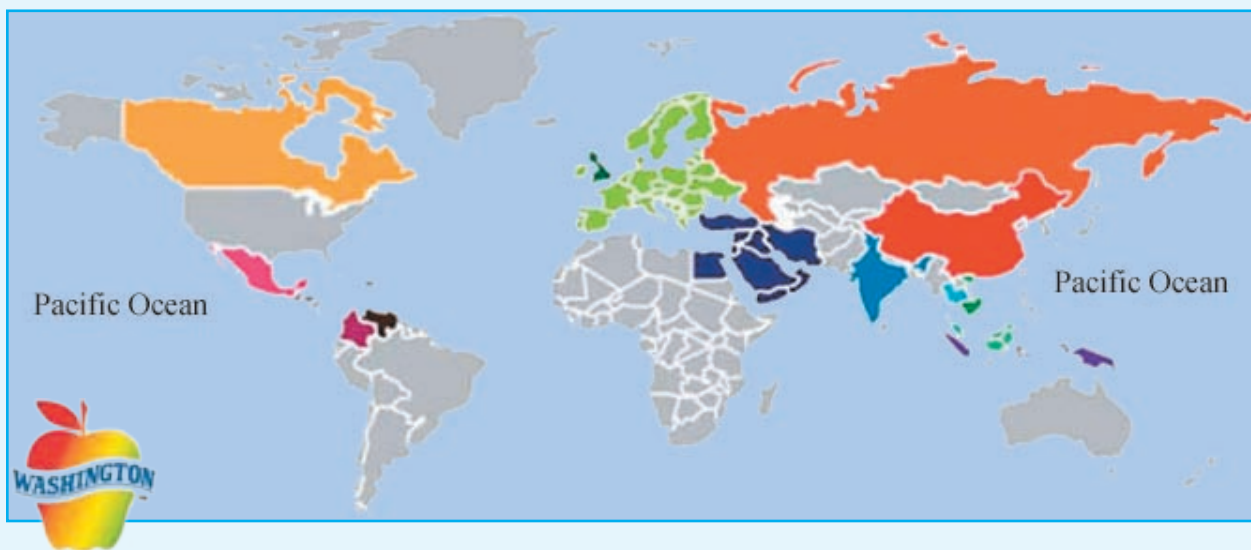
Wheat is one of many crops shipped from our ports. We export 85-90% of our soft white wheat each year. Knowing that this class of wheat is especially suited for flat breads and Asian noodles, as well as cookies, cakes, and crackers, it is logical that our top markets (2010) are: Japan, Philippines, South Korea, Yemen, Indonesia, Thailand, Nigeria, Taiwan, Iran, and Chile. **How many of these are Pacific Rim countries?** Besides bulk commodities, like shiploads of



wheat, we also export high value processed products like meats, dairy items, dried and canned fruits and vegetables, packaged foods, and wine. As people in other countries have increased income, these foods become a larger part of our exports. We **import** foods because that allows us to have fresh fruits and vegetables available throughout the year, as well as some commodities like coffee, tea, and cocoa that we cannot produce.

**THE DEFINITION OF EXPORT IS:** *to send to another country for trade or sale*

**THE DEFINITION OF IMPORT IS:** *to bring in from another country for trade or sale*



## Washington Apple Countries

Washington produces nearly 55% of all US apples, but accounts for 90% of US apples exported to other nations. The slogan 'The Best Apples on Earth' certainly describes Washington apples that are shipped to 60 countries around the world!

Red Delicious is still Washington's leading export variety but each year international consumers are buying more Gala, Golden Delicious, Granny Smith, and Fujis. Newer varieties such as Honeycrisp, Cameo® and Pink Lady are also becoming popular. The top ten apple export countries in 2010 were: Mexico, Canada, India, China/Hong Kong, Indonesia, Taiwan, United Arab Emirates, Saudi Arabia, Thailand, and Russia. **Can you find these countries on the map?** Check your geography skills, go to <http://www.bestapples.com/kids/games/countries.shtml> to work the countries puzzle challenge. (You will also like the Washington Counties Puzzle at the same website).

# Technology has Changed



## High Density Planting

Full-sized apple trees used to be planted 20 to 35 feet apart (about 150 trees per acre). They would start to produce fruit 5-8 years after planting. Today, using dwarfing rootstocks, farmers can plant 500 to nearly 2,000 trees/acre. Apple production will start 2-3 years after planting.

Most high density apple trees are spindly spikes. They are just an inch or two in trunk diameter, with a few flimsy branches that must be tied to posts and wire to support the heavy fruit they bear and get the best ripening by the sun. It looks like a fruiting wall of apples grown in a narrow strip right down the orchard, similar to a vineyard. Smaller trees mean less ladder work, saving growers time and money.

## Integrated Pest Management (IPM)

IPM uses several tools (biological, chemical, behavioral, cultural and genetic) to avoid crop loss, produce quality fruit, and protect the environment. The biggest pest of apple is the codling moth. The larva (caterpillar) of this moth bores into the apple ruining the quality.



Growers use **pheromones** (chemicals that insects make to attract mates) to confuse the insects. Apple growers have been able to reduce the use of insecticides by as much as 50%

by using pheromones to manage codling moth.

## Technology Has Improved Machines

Fruit can be sorted by cameras and computers. After apples are washed, polished, and waxed they are dropped into cups



on a moving belt where a camera takes four pictures that creates a three dimensional computer view. The color and diameter are determined and scars and blemishes detected. The apple is evaluated for weight, color, defects, and shape. The computer signals each belt cup to drop its apple at the correct packing box, perhaps hundreds of feet down the line. The machine made by Aweta is fast; each camera can evaluate 10 apples per second.

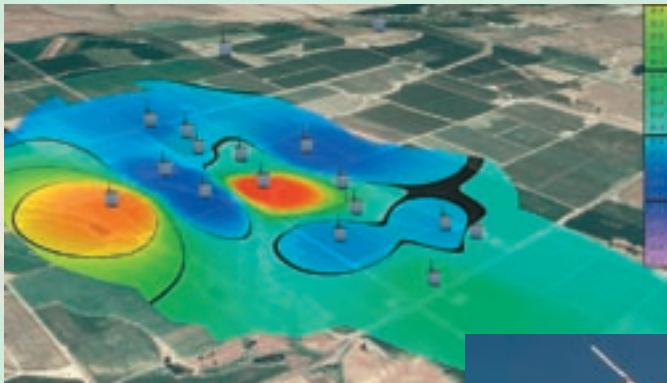
## Machine of the Future?

Apples are placed in vacuum tubes that deliver them to a bin, replacing picker bags and ladders.



Dan Wheat/Capital Press

# Advanced Apple Production



The image above shows two wind machines doing their job to protect the fruit in Washington State

The orchard wind machine draws cold air up and warm air down to protect trees from frost damage



## Improved Packaging Materials

“A rotten apple spoils the barrel” is a saying that is easier to understand when you know that we used to store and ship apples in barrels. Without refrigeration, special storage conditions, and



well designed packaging, apples would get bruised and start to decay. One bad apple could spread the rot to other apples in the barrel. Today we have many packaging



designs to cushion the fruit to prevent bruising and to keep the apples separate from each other.



## Controlled Atmosphere (CA) Storage

Eating crisp, juicy Washington apples year-round is possible due to controlled atmosphere storage that involves careful control of temperature, oxygen, carbon dioxide and humidity in sealed rooms. As apples ripen, they naturally take in oxygen and give off carbon dioxide. If we reduce the oxygen, we will slow ripening. Oxygen levels in the sealed rooms are reduced, usually by adding nitrogen gas, from the approximate 21% in the air we breathe to 1 or 2%. Temperatures are kept at a constant 32 to 36 degrees Fahrenheit. Humidity is maintained at 95% and carbon dioxide levels are also controlled. Exact conditions in the rooms are set according to the apple variety. Computers help keep conditions constant. Washington now has the largest capacity of CA storage of any growing region in the world.

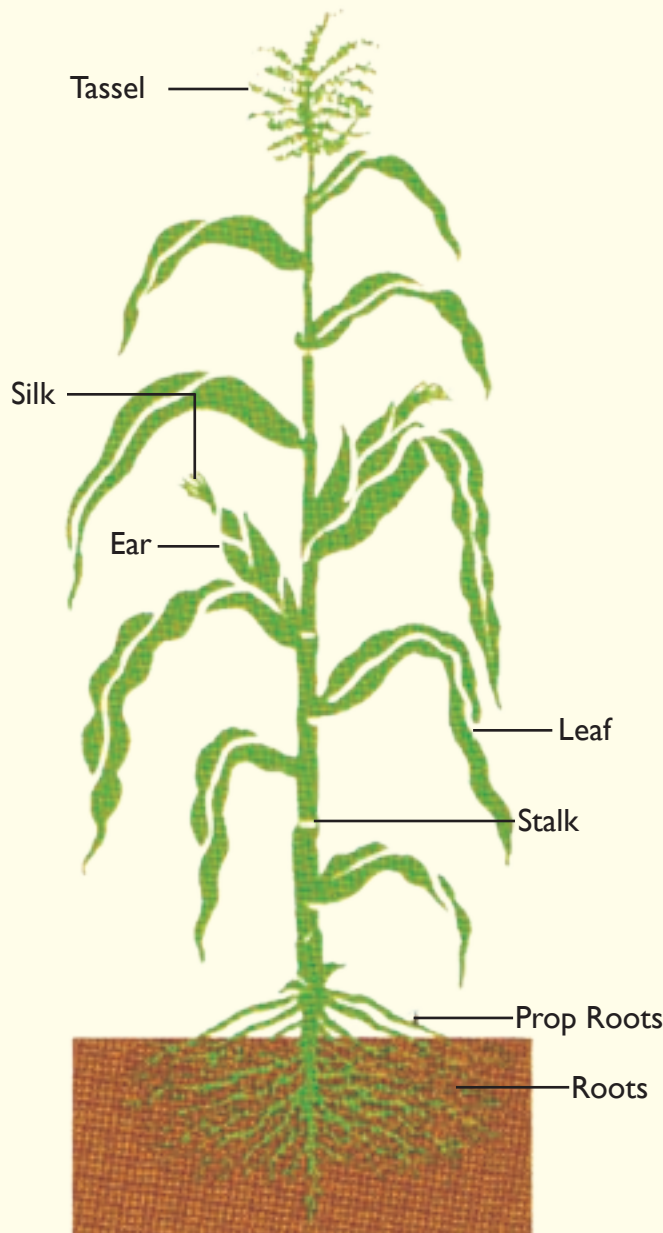


## Genetics—DNA—Genomes

A special branch of biology is called **genetics** and deals with **heredity** (passing characteristics from parents to the next generation). **DNA** (deoxyribonucleic acid) is found in every cell and carries the genetic information. Genes are distinct portions of a cell's DNA. Genes are coded instructions that determine a particular characteristic, like the shape and color of an apple variety. A **genome** is a DNA map of all the thousands of genes for an organism. It took two years for scientists from 20 institutions (including Washington State University) to unravel the genetic code of the Golden Delicious apple. It is the largest plant genome uncovered to date (57,000 genes, compared to the human genome of about 20,500 genes). Mapping the genome will make trait selection faster, resulting in new and improved apple varieties.



## The Corn Plant



A typical corn plant is anywhere from 5 to 12 feet tall. The **tassel** grows at the top of the cornstalk. It contains hundreds of small flowers that produce pollen.

The tough, jointed **cornstalk**, or stem, resembles bamboo.

At each joint of the stem, a long, sword-like leaf curves outward and downward, ending in a pointed tip. Ears of corn grow from the places where the leaves join the stalk. A corn plant may have one ear, or as many as eight. **Husks** (special kind of leaves) enclose and protect each ear.

An ear consists of a corncob covered with rows of **kernels**, (the seeds of the corn plant). Each kernel has what looks like a silk thread that runs from the kernel up the row, and sticks out of the husk at the end of the ear. This thread is called the corn **silk**. Each silk carries pollen to a single developing kernel of corn. In harsh, hot summers if the silks dry out before pollen travels down the cob, there will be gaps where no kernels are developed. The average corn ear has 16 rows. Corn ears always have an even number of rows. A typical ear has approximately 800 kernels, but this number can vary from 500-1,200 kernels.

A root system with branches supports the green stalk. **Prop roots** grow out of the stalk above the ground to help support the plant against the wind.

## Hybrid Vigor

When different plant strains are crossbred, the resulting hybrid plants are usually more vigorous than their parents. Crossing different strains of corn results in higher yields and stronger plants. This is **hybrid vigor**. Commercial corn is nearly 100% hybrid seed. Biotechnology and mapping the corn genome have given plant breeders even better tools



to create new hybrid seeds. The introduction of herbicide and insect-tolerant corn hybrids didn't just mean better weed control, less insect damage, and higher yields. Farmers use significantly fewer pesticides and make fewer trips across the field. It adds up to big savings in equipment, fuel and labor-related costs.

Less than 1 % of the country's crop is sweet corn – the kind we eat frozen, from a can, or fresh off the cob. The ears are stripped from the stalks and transported to the food processing plant.





Combine harvesting corn

## More With Less

Eight of the largest corn crops in history occurred in the last eight years. Herbicide and insect-tolerant hybrids mean using fewer chemicals and fertilizers. High-tech equipment places hybrid seeds at the correct depth in the soil with the best spacing between seeds, and puts fertilizer where it will be available for the growing plant.

## Food and Fuel

Corn is a grass, and belongs to the group of six true grains, or **cereals**, that also includes wheat, barley, oats, rice, and rye. 85% of US produced grain corn is fed to animals. Another valuable use of corn is fuel ethanol for cars. 70% of the corn kernel is

used to make ethanol. The remaining 30% becomes high protein, high fat, livestock feed.



Cutting corn silage

Some corn is harvested while the plant is still green and the corn kernels have not dried. The entire plant is chopped and stored as **silage** for animal feed.

## Good for the Environment

You can find corn-based plastics in a growing number of utensils, gift cards, safety seals, bags, plant containers, weed barriers, water bottles and more. They will break down completely when composted.

## Name the BIG FOUR!

There are about 380,000 kinds of plants. About 100 are regularly grown and eaten as human food. Amazingly, over half of the world's food comes from only four plants. Three are grains, and one is a tuber vegetable.

Which one does NOT grow in Washington?



First grown by ancient tribes in the mountains of South America, this food is actually an underground storage unit. The roots collect more water and food than the growing plant can use at one time. The plant stores the excess food in oval shapes, called **tubers**. This crop produces more pounds of protein per acre than corn, rice or wheat. Idaho leads US production but **Washington grows more pounds per acre**.



One-seventh of all the farmland in the world is used to grow this grain - far more land than for any other food crop. It is a staple food for 35% of the world's people and is used to make breads, cookies and noodles. North Dakota, Kansas, Montana, Washington, Texas and South Dakota were the leading production states in 2010.



Christopher Columbus found this grain growing in North America in 1492. American Indians helped the Pilgrims survive by teaching them how to plant and cultivate it. Today, it is our country's number one agricultural crop. Iowa, Illinois, Nebraska, Minnesota and Indiana lead US production.



It's a staple food for half the world's people. Native to Asia, it has been grown and eaten there for thousands of years. It grows in warm areas and plants must be under water for most of the growing season. In the US, it is grown mostly in Arkansas, California, Louisiana, Mississippi, Missouri, and Texas.



# My WASHINGTON PLATE

## Fruit

Apples

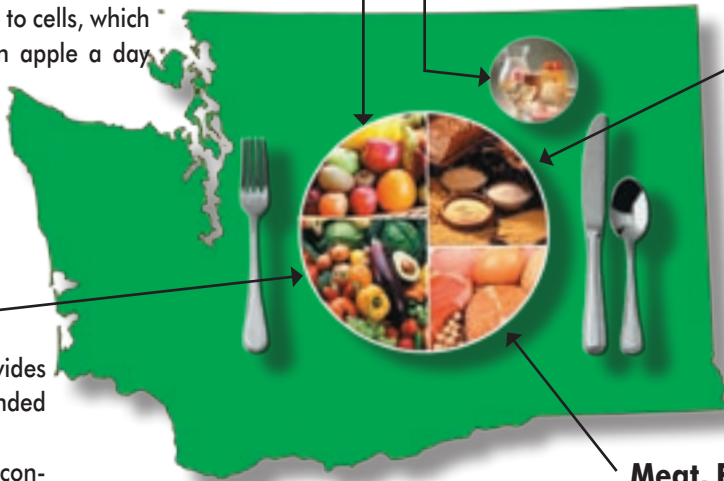
Eat the apple peel. Two-thirds of the fiber and lots of antioxidants are found in the peel. Antioxidants help to reduce damage to cells, which can trigger some diseases. ("An apple a day keeps the doctor away")

## Dairy Group

Part of the diet of dairy cows is by-products from making ethanol from corn. The milk that cows produce is a major source of calcium in our diet. Children need 3 cups of milk products each day.

## Grains

Corn is ground for tortillas, corn-flakes, and cornmeal muffins. Wheat is made into flour for bread, bagels, pasta, and more  
Rice



## Vegetables

Sweet Corn (1 ear of corn provides 10% of the daily recommended amount of fiber)

Potatoes (a medium potato contains 16% of the daily recommended amount of fiber and 35% of the daily recommended amount of vitamin C)

## Meat, Fish, and Eggs

Grain corn is fed to cattle, pigs, lambs, chickens, and fish to grow these protein rich foods. Eggs are part of this group.

# Congratulations



Sam Rife's drawing showing the importance of forestry in Clallam County is the winner of the Ag@School Artwork Contest. (Mrs. Frenette's 4th grade class at Queen of Angels Elementary in Port Angeles, WA)

Rules for the next contest are found at: [www.waic.net](http://www.waic.net).

## ASK BINGO

Bingo is one smart dog! We can ask Bingo any question about farming and he will find the answer for us. Let's ask Bingo,

**"Can you eat other eggs besides from chickens?"**

Bingo says: Of course. Goose and duck eggs are often available at Farmers' Markets. Turkey eggs are not often found for sale because turkeys are kept almost entirely for meat bird production. Quail eggs are considered a delicacy and used in gourmet restaurants. They are available from game bird farms. All these eggs are similar in taste, but not exactly the same because they vary in fat content. Shells on the larger eggs tend

to be tougher and harder to crack. The US has more than 9 billion chickens (458 million laying hens and 8.9 billion broilers—or meat birds). We produce more than 90 billion chicken eggs each year. We have more tur-



keys than any other country in the world (270 million) and we keep about 24 million ducks.

Eggs are incredibly edible! Like meat and fish in the protein group, eggs contain high quality protein. Egg protein has just the right mix of essential amino acids needed by humans (ones that our bodies cannot make). In addition, eggs have thirteen essential vitamins and minerals, all for just 70 calories. The egg yolk is the major source of the egg's vitamins and minerals.

**Do you have a question for Bingo? Send it to: [bingoquestions@gmail.com](mailto:bingoquestions@gmail.com)**

