



Ag@School

Volume 20, Issue 2 2020/2021

Published by Washington Agriculture in the Classroom



1790

4 million Americans
90% lived on farms

1850

23 million Americans
64% lived on farms

1950

151 million Americans
12.2% lived on farms

2010

315.5 million Americans
1.8% live on farms

2020

331 million Americans
1.3% live on farms

Agriculture in a Changing World Revolution: A "sudden or complete change"

1820 - 1870 Industrial Revolution in the US

A change from hand and home production to machine and factory production



1837 John Deere invents self-cleaning plow

1920 - 1950 Mechanical Revolution in agriculture

Change from machinery being pulled by horses and mules to using tractors, combines, and other specialized equipment



Massey Harris 25 Tractor
1931 - 1938

1945 - 1960 Chemical Revolution in agriculture

Use of man-made fertilizers and chemical pesticides targeting specific weeds and insects



1965 - 1975 Green Revolution

Dramatic increases in production of wheat and rice in developing countries due to use of genetically improved seeds



Wheat Plant

1975 - Electronic Revolution

Using computer technology in agriculture

1980s - Biotechnology Revolution

Using biology and cellular technology to develop new products.

1982 - Produced human insulin from bacteria



Some crops are GMOs (genetically modified organisms) where a precise gene has been altered to improve the plant in a specific way

1990s - Electronic Revolution continues

Use of computer technology and global positioning satellites (GPS) to guide equipment
1996 - GPS plus GIS Revolution - Farmers use satellite technology (Global Positioning System) to track and plan their farming practices with Geographic Information Systems



2000s - Now - High Speed information highway revolution

The internet gathers and communicates information at lightning speed, wi-fi can operate systems remotely, and human labor is replaced with machines, including sensors, 3D cameras, lasers, drones, etc.



Today's Children... Tomorrow's Leaders

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



AGRICULTURE IN A CHANGING & GROWING WORLD

People continually find better ways of doing things. When people apply what they have learned about science; that's technology!

No industry has made better use of technology than agriculture. Improvements to agriculture have changed America from an **agrarian** to an **urban** society. Only 1.3% of our population are considered farmers and ranchers. This allows everyone else to live in cities and work in other careers. This means more doctors, more teachers, and more scientists.

Even though 1.3% of the US lives on farms, 17% of our total workforce is employed in agriculture. Growers produce the raw products and others turn them into things we eat and use.

Historically, the early 20th century mechanical revolution put tractors, combines, and other specialized machinery in use rather than horses and mules. Then in the mid-20th century, agriculture experienced a revolution in chemical and genetic knowledge that allowed **high-yield agriculture**. In the late 20th century, agriculture benefited from the electronic revolution, using computers and satellites.

Prior to 1900, nearly all increases in food production came about because more land was brought into production. Now in the 21st century almost all increases must come from higher yields and be based on science and technology.



High-Yield Agriculture

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

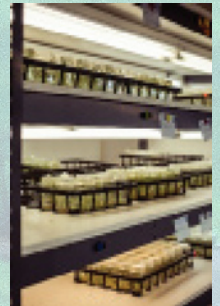
- **World food production has tripled since 1950 with no land use increase**
- **Land is available for other uses like wildlife habitat, wetlands, and recreation**

No Ordinary Potato!

At Dick Bedlington Farms in Lynden Washington, young potatoes are grown in a greenhouse, but before they end up there, they start in a laboratory by a process called tissue culture. Plant **tissue culture**



is a collection of techniques used to grow plant cells under sterile conditions on a nutrient culture **medium**. This practice allows you to make many exact copies of the desired plant. Tissue culture is a growing industry that is used



in many agricultural fields. With potatoes, we start with a whole potato and place it in a brown paper bag and let the potato begin to sprout. After it sprouts, sprouts are removed and the process of cleaning the sprouts begins. After the sprouts are cleaned we take them to our tissue culture "hoods" where light is brought from above and air is forced through the area to keep any contamination out! Sprouts are placed in a gel like substance that helps to promote the growth of a plant sprout. The gel has lots of sugar and nutrients that help jumpstart growth. The sprout will have produced about 4-5 leaves and then propagation starts. We cut the stem on the plant sprout about 1 millimeter under the leaf. This then gets placed in a new container with the gel in it so the leaf is resting right on the surface of the gel or "**media**". The plant usually has a part of the stem already growing to give it a little jump start. Process is until we have enough plants to plant in our greenhouse! It is very sanitary; everyone must wash their hands and wear lab coats. Our farm is one of the only farms in Whatcom county that does tissue culture on its own potatoes! We use technology to make sure that the grow lights turn on at the right time, and that the temperature is correct when growing them. We still need to check on them daily to make sure they are healthy and growing correctly. Our computer system monitors the temperature and we have a box in each room that can change the light settings!

Even more technology is used in the greenhouses! Within same computer system that works in our labs, we can check on our growing potatoes in the greenhouses. The computer system, called "Argus", monitors our greenhouses for us. The system checks temperature, humidity, fan usage, water usage, watering times, and much, much more! We can log on in the morning and look at a graph that tells what happened overnight, so we don't have to stay overnight with our potatoes! We have been able to get the best crop by adding these features in our greenhouses and producing quality, nutritious potatoes.

Laboratory Manager at Dick Bedlington Farms



Corn, More with Less



Because of science and technology, eight of the largest corn crops in history occurred in the last eight years. Science has developed plants that are tolerant of some **herbicides** (chemicals that kill weeds that compete with crops for space and water), and also some plants that will resist insect pests. These plants mean that farmers use fewer chemicals. 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 most available for the growing plant, thus using less fertilizer.

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 **ethanol** fuel for cars. 70% of the corn kernel is used to make ethanol. The remaining 30% becomes high protein, high fat, livestock feed.

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. Sweet corn that humans eat is yet another type of corn.

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.



Hand Milking to High Tech

When the first dairy cow arrived in Washington more than 75% of the US population lived on farms and most of them had a cow or two for fresh milk. Milking was done by hand into a metal bucket. Without refrigeration excess milk had to be sold or traded quickly to neighbors.



Mechanical milking machines were developed around 1930 but even then the average herd size was only 11 cows. The most modern dairies at the time could only milk 30 cows per hour and there was still much hand labor involved. Average yearly production was only 718 gallons per cow.

Today, technology has dramatically changed the dairy industry. Milk is never touched by human hands nor is it exposed to open air. Closed systems transfer milk directly from the cow through pipes to cooling tanks. Then tank trucks deliver the milk to processing plants. Modern dairies can milk 300 cows per hour and computers record each cow's production. (In fact the largest rotary parlor can milk nearly 700 cows per hour as they take a nine minute ride around the carousel). Advances in animal nutrition and health have increased average production per cow to 2500 gallons per year.

Some farms have added robotics to their dairies with individual robots that do specific tasks to entire robotic milking machines that milk the cow! Each cow has a neckcollar that contains her personal data. After the cow enters the robot

machine, she is identified by that collar which triggers the milking process. This includes 3D cameras and lasers within this technology that aids in the process.

Next time you drink a glass of milk or enjoy ice cream, remember the technology that made it possible!



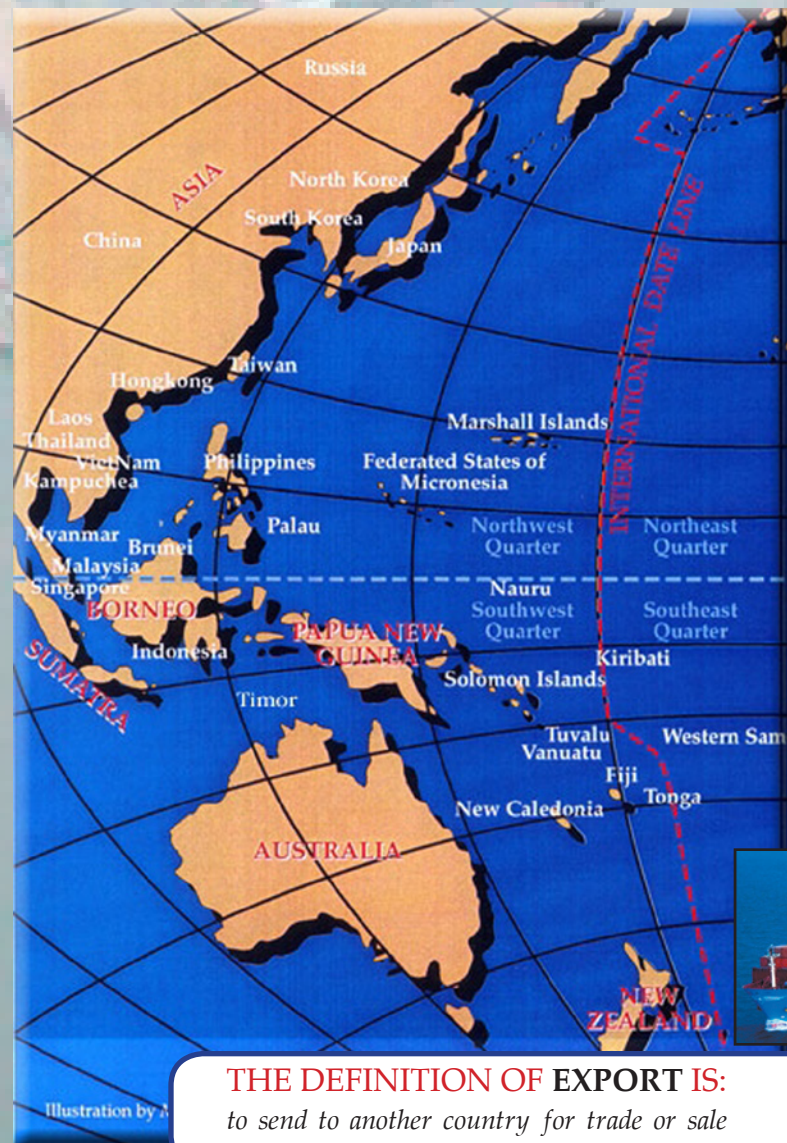
How is Washington Trade Bo

Washington's location on the **Pacific Rim** allows for advantageous international trade. The 10 countries that Washington exports to are Canada, Japan, China, South Korea, Mexico, Philippines, Hong Kong, Vietnam, and Indonesia. By ship, Washington ports are just about twice as close to the Asian Markets as California ports are to the Asian Markets. Agriculture and food exports total 20% of everything that is exported from Washington (2019 WSDA).

How do we increase exports?

Trade is not always a simple process. Countries can impose **tariffs** (taxes on imported products). If consumers want to buy the imported products they must pay a higher price to cover the cost of the tariff. Tariffs and other trade barriers can be used to protect producers within a country from foreign competition. Tariffs can lead to trade wars as exporting countries retaliate with their own tariffs on imported goods.

One method of increasing trade is to make trade agreements between countries. **Free Trade Agreements (FTAs)** have proven to be one of the best ways to open up foreign markets to U.S. exports. We currently have 20 agreements with 14 countries.



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



SUPPLY AND DEMAND

Prices are determined by two groups of people: Producers and consumers. Producers make or create something to sell and consumers buy or use that product. The amount of something offered for sale is called **supply**. The amount that people are willing to buy is called **demand**. The price you pay in the store usually depends on which of those is the highest at a given time. If demand is high, prices usually go up. If supply is high, prices usually go down.

Boasted By The Pacific Rim ?

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1. What is the Pacific Rim?
2. Can you name five countries on the Pacific Rim
3. On the map put an 'X' on the State of Washington
4. Use a globe to trace the polar air route from Washington to Europe



Trade –

A Heritage In Washington

Our tradition as a trade state began back in the early nineteenth century with the fur trading activities of Hudson's Bay Company and the Canadian North West Company. Seattle became a major seaport during the Klondike gold rush by selling provisions to miners and transporting prospectors to the Alaskan gold fields. In 1916, William Boeing started building wooden airplanes in a small red barn. Today Boeing Company is the country's largest exporter.

Global demand for the things we produce helped to build our state and drives our economy today. More than 40% of all Washington jobs are linked to trade. The value of Washington exports, per resident, is more than twice the national average. More than \$15 billion in food and agricultural products were exported through Washington ports in 2019.

Washington products that are especially reliant on global trade include wheat (up to 90% of the crop is exported each year), potatoes (up to 70% are exported in the form of French fries), and tree fruit (approximately 33% of apples and 25% of cherries are exported each year).

THE DEFINITION OF IMPORT IS:

to bring in from another country for trade or sale

See if you can fill in the following sentences and discuss scenarios.

1. A heavy frost freezes Florida's orange crop before harvest. Supplies of oranges for juice drop. The price of orange juice will _____.
2. More farmers around the world are now growing wheat to export. Supply is greater than demand. The price of wheat will likely _____.
3. Hurricanes damaged oil drilling rigs in the Gulf of Mexico. There is less oil on the market. The price of gas will _____. Discuss how this affects what you pay for things in the supermarket?

What's Happening?

Technology in food packaging, processing and preservation

1803 – Dairyman Thomas Moore patented the first refrigerator - an ice-filled tub lined with rabbit fur and wrapped in metal. His butter could now be transported in warm weather without melting. And, folks were willing to pay more for butter that wasn't soft.

1858 – The humble metal can was patented in 1810 as a way of preserving food. But, cans weren't popular with housewives until 1858 when the first can opener was invented. Mason jars, used for home canning, were first sold in 1858 too.



Louis Pasteur

1862 – Frenchman Louis Pasteur found he could kill bacteria and mold in food by applying heat at temperatures below the boiling point. This process, called pasteurization, is one of the greatest public health advances of all time.

1867 – The first ice-cooled railcar was patented and two years later the first fresh fruit was transported from the west coast to the east, beginning the age of transcontinental shipping

1923 – Using an electric fan and slabs of ice, Clarence Birdseye invented a system of packing fresh food into cardboard and freezing it. Today Birdseye is the U.S. leader in frozen vegetables

What was happening at the same time in Washington?

1805 – Two years after Moore invented the first icebox Lewis and Clark arrived in what is now Washington State

1847 – Industry begins in the Washington Territory with the opening of the first sawmill on Puget Sound.

1865 – The world's first salmon cannery is started at Eagle Cliff, near Longview on the Washington/Oregon border.

1875 – A petition was presented to the Legislature to ban pigs from running in the streets! It's true! The law finally passed in the 1880's because politicians felt hogs running in the streets might lead Easterners to think that Washington was not civilized enough to be allowed entry into the Union.

1st WA Grange meeting on 2nd floor Pioneer Store Camas, WA 1889



Washington State Flag

1889 – Washington becomes the 42nd state.

1902 – The Reclamation Service begins irrigation projects in Yakima and Okanogan Valleys to facilitate farming.

1920 – While Birdseye was inventing frozen vegetables, Adams County farmers still needed 15,939 horses and 2,239 mules just to farm their wheat

1803

1805

1847

1858

1862

1865

1867

1875

1889

1902

1920

1803

1923

Has Technology Improved Production Agriculture?

Precision farming: allows small areas of land within a field to be managed separately so that the best possible crop yield will be reached using the exact amount of seed, fertilizer, and chemical for each small area. This farming method requires several technologies like **GPS** (global positioning system). GPS uses a network of satellites orbiting the earth to transmit exact locations to computers on the ground. GPS can automatically guide huge farm machines to stay along a track hundreds of meters long with only a few centimeters of difference.

Geographic Information Systems (**GIS**) is used to collect specific data about various locations within a farmer's field. Data is gathered from multiple soil samples, yield monitors from harvest, even aerial photographs. GIS plus GPS can reduce the number of passes needed to cover a field and save seed, chemicals, fertilizer, fuel, and time. Skips and overlaps are eliminated and work can be done even at night or in dust or fog.



Drones: or unmanned aerial system (UAS), use high tech cameras to assess the status of crops and fields. Drones give the aerial view and precise information back the grower that can identify crop health and assess crop damage. Information gathered can assist with irrigation management and utilizing sensory data can determine specific harvest times.

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.



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, from the approximate 21% in the air we breathe to 1 or 2%, usually by adding nitrogen gas. 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 has the largest capacity of CA storage of any growing region in the world.

More efficient irrigation: The modern center pivot irrigation system has come a long way from just flooding fields with water. The system uses a long water pipe that is mounted on motorized wheels and has one end connected to the water line at the center of the field. When operating, the irrigation system swings in a circle, sprinkling water as it rotates. These systems are computer controlled using GIS (Geographic Information System) and can even be operated from the farmer's cell phone. Irrigation is the reason our farmers lead the nation in the yield/acre of corn and potatoes.



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.



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. Kansas, North Dakota, Montana, Washington, and Oklahoma are the leading production states in the U S.



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.

LIBRARY CORNER

Back in the 1830s, who was a young blacksmith from Vermont, about to make his mark on American history? John Deere, that's who! Who moved to Illinois, where farmers were struggling to plow through the thick, rich soil they called gumbo? Who tinkered and tweaked and tested until he invented a steel plow that sliced into the prairie easy as you please? Long before the first tractor, who changed farming forever? John Deere, that's who!



WASHINGTON STATE GRANGE

Organized in 1889, two months before Washington Territories became a State, the Washington State Grange is a family-based organization. Women and men have always been full and equal members in the Grange. Children, youth, and young adults also have important roles within our organization.

The Grange encourages community service, supports education for all, and champions Washington agriculture. The Grange is committed to providing accurate information about Washington agriculture to all people.

Many local Washington Granges participate in Words for Thirds, part of the national Dictionary Project. These Granges donate FREE dictionaries to local 3rd graders. More than 7700 dictionaries are annually donated to Washington 3rd graders.

The Grange offers two youth programs. Grange Youth Program begins at age 14. The Junior Grange is open to 5-14 year olds. Both programs train youth to engage in leadership roles and community service projects. For kids aged 9-14, the State Grange sponsors several week-long Summer Camps. Camps are held at various places throughout our State, all on or near water, for Junior Grangers and all other interested children and youth. Interested in checking out a camp near you? Go to wa-grange.com/JuniorCamps.aspx

