

# Ag@School

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## CAN AGRICULTURE CONTINUE TO FEED THE WORLD?



### YES! BY USING TECHNOLOGY!

Our world population will grow to more than 9.8 billion people by 2050!  
The world's farmers & ranchers will have to grow 60% more food than what is now produced.

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

**tech•nol•o•gy** (tek nol' əje), 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. Less than 1% of our people now work the land. This allows everyone else to live in cities and work in other careers. This means more doctors, more teachers, and more scientists.

Even though less than 1% 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**

### 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.



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.



### Think and Discuss

How does technology help you? How does it help farmers? A stick is better than nothing, a shovel is better than a stick, a backhoe is better than a shovel. Discuss what technologies you use to do homework that a farmer also uses on his farm.

1790

1850

1950

2010

2020

4 million Americans  
90% lived on farms

23 million Americans  
64% lived on farms

151 million Americans  
12.2% lived on farms

315.5 million Americans  
1.8% live on farms

329.5 million Americans,  
less than 1% on farms

# Agriculture in a Changing World

## Revolution: A "sudden or complete change"

### 1820 - 1870 Industrial Revolution in the US

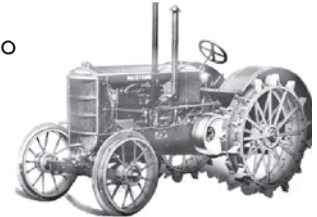
A change from hand and home production to machine and factory production



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



GPS Lightbar  
Guidance System

### 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 and the latest in technology

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, robots, drones, etc.

2008- GMO algae is used to make fuel



Some algae contains more than 60% oil and can even be grown in salty water.



# Where in the World

Washington sits on the Pacific Rim, situated mid-way between Asia and Europe. Thanks to our geographic location, we have a favorable international trade advantage. By ship, our ports are about two days closer to Asian markets than California's. By air, the polar route (over the top) brings Europe as close as Asia.

## WHERE ARE OUR CUSTOMERS?

These Pacific Rim countries are major trading partners with Washington. Can you find them on the map and write in their number?

Canada \_\_\_\_\_ Mexico \_\_\_\_\_  
China \_\_\_\_\_ Philippines \_\_\_\_\_  
Japan \_\_\_\_\_ South Korea \_\_\_\_\_



## WHERE DO OUR PRODUCTS GO?

Find the country that imports our product and write the number of the country in the blank.

1. Timothy hay from Kittitas County feeds racehorses in Japan. \_\_\_\_\_
2. Mexico is the biggest customer for pears. \_\_\_\_\_
3. The United Kingdom is the #1 importer of peppermint oil which is used in tea, candy and chewing gum. \_\_\_\_\_
4. Tulip bulbs from Skagit County are planted in yards in Taiwan. \_\_\_\_\_
5. Chickpeas are exported to Pakistan where they are used in hummus and many traditional dishes. \_\_\_\_\_
6. Apples are extremely popular in Latin America, with exports increasing in popularity to several Central and South American countries yearly. \_\_\_\_\_
7. Cattle hides are made into shoes in China. \_\_\_\_\_
8. Cherries are a favorite in the Philippines. \_\_\_\_\_

## 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

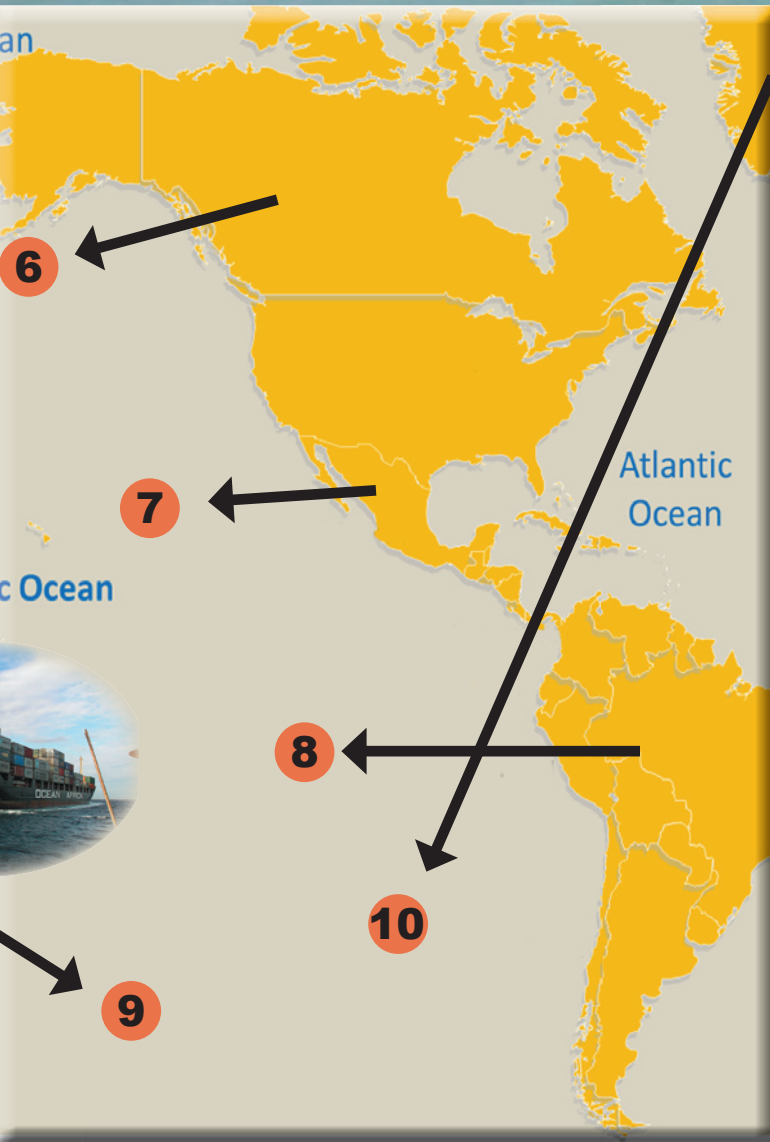


## SUPPLY AND DEMAND

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.

# World is Washington?

1. What is the Pacific Rim?
2. Can you name the 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 IS A WASHINGTON TRADITION

Washington is the most trade-oriented state in the U.S. One third of all jobs in our state are related to trade. We have only 2% of the US population yet we rank 3<sup>rd</sup> among exporting states. Only California, and Louisiana export more than we do.

Our state is home to the country's largest exporter, the Boeing Company. Agriculture products follow averaging nearly \$7.7 billion per year.

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

## TOP 8 WASHINGTON-GROWN OR PROCESSED FOOD AND AGRICULTURE EXPORTS:

- 1) **Fish & Seafood** *Top Markets:* Canada, China, Japan
- 2) **Wheat** *Top Markets:* Japan, South Korea, Philippines
- 3) **Frozen French Fries** *Top Markets:* Japan, South Korea, Philippines
- 4) **Apples** *Top Markets:* Mexico, Canada, Taiwan
- 5) **Dairy Products** *Top Markets:* Indonesia, Vietnam, Japan
- 6) **Hay** *Top Markets:* Japan, China, South Korea
- 7) **Hop Cone & Extracts** *Top Markets:* Belgium, United Kingdom, Canada
- 8) **Beef** *Top Markets:* China, Japan, Hong Kong

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?

## FACTS:

- In 2021, Washington exported nearly \$7.7 billion worth of food and agricultural products.
- For every \$1 million in exports, about 20 jobs are created in our state.
- 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).

# 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.



## 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!



## Washington Innovations

### Combine Automatic leveling device:

The combine shown here is harvesting wheat, but it is also used in Washington to harvest corn, barley, canola, mustard, garbanzo beans and many other crops. It harvests a 30-40 foot wide cut and when fully loaded with grain weighs over 25 tons. For harvesting the hillsides of the Palouse an automatic leveling device was patented in 1946 by mechanical engineer R.A. Hanson from Spokane, Washington.



### Raspberry Harvester:

This Korvan (now Oxbow) 9000 raspberry harvester, invented and built in Lynden, Washington, harvests ripe berries by gently shaking the bushes. Because of the high cost of picking by hand, most raspberries in Washington are now harvested mechanically. The self-propelled harvester travels about 1 mile per hour during the harvest process.



### Robotics:

Robots are becoming increasingly popular to meet the demands of labor intensive procedures. Robots have many applications in agriculture and are designed for a specific task that might range from fruit picking and sorting, weeding, planting, and even driverless tractors/sprayers and robotic milkers.

Engineers and scientists at Washington State University Tri-Cities and the WSU Center for Precision and Automatic Agricultural Systems (CPAAS) are creating a practically adoptable robot that will pick apples as efficiently as people.

The robot features an arm and "hand" in which eight motors operate in congruence with a vision system to delicately grasp and twist the fruit off the tree as a human does.



## 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.



### 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.

## Did You Know?



**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.



What foods do you consume that are pasturized? Think about how that invention improved health?

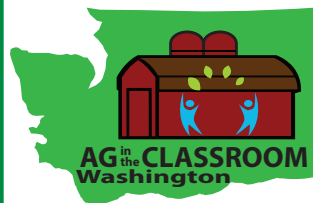
### LIBRARY CORNER

#### The Boy Who Changed the World

This book tells the story of Nobel Laureate, Norman Borlaug. Norman grew up as an average farm boy in Iowa, but later his work as a plant scientist reached far and wide to help improve the growth of wheat, rice, and



corn all over the world. This book highlights the benefits of emerging science, but also has an underlying message to teach kids that, "Every choice you make, good or bad, can make a difference."



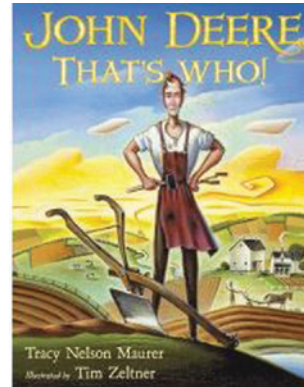
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### LIBRARY CORNER

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!