



# Ag@School

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## Agriculture in a Changing World

### 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 hogs 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

**RESEARCH - What has happened in the last 100 years? Complete the timeline**

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.



## 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. 1.3% 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 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.



## Horses to Horsepower

For nearly 200 \_\_\_\_\_, animals (horses, oxen, and mules) provided the "horsepower" on farms. In 1920 two humans and eight horses were needed to care for a 160 acre farm and it took 40 days to do the plowing. One fourth of the acreage of every farm was used just to grow \_\_\_\_\_ for the horses.

Harvesting 100 bushels of wheat in 1925 required 15 man-hours of labor and a machine pulled by 32 \_\_\_\_\_. Today, one man and a self-propelled combine can harvest 100 bushels of wheat in 15 \_\_\_\_\_ or less.

## Precision Farming



precision farming method requires technologies like GPS (Global Positioning System). Networks of satellites orbiting the \_\_\_\_\_ transmit exact locations to the GPS 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.

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 \_\_\_\_\_, fertilizer, and chemicals for each small area. This



## More Efficient Irrigation

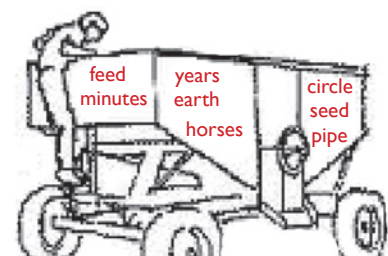
The modern center pivot irrigation system has come a long way from just flooding fields with water. The system uses a long water \_\_\_\_\_ that is mounted on motorized wheels and has one end connected to the water line at the center of the field. When operating, the irrigation system swings in a \_\_\_\_\_, 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.

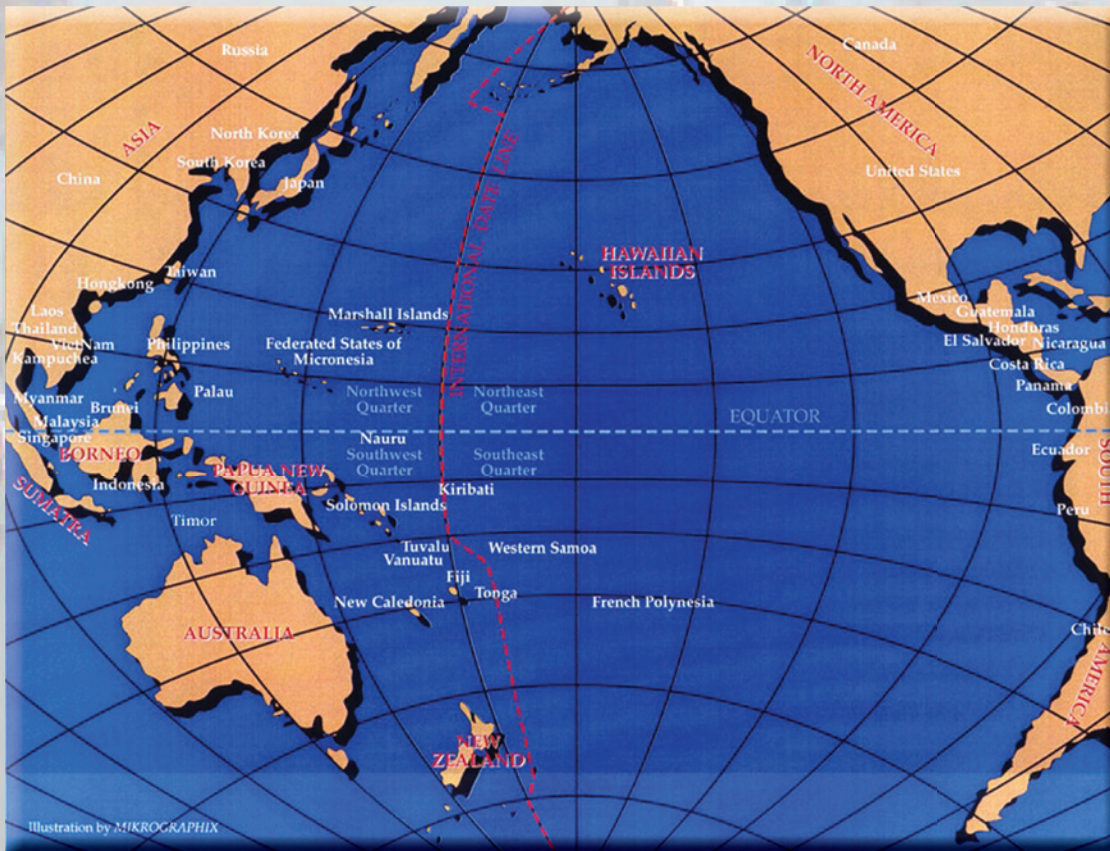
### Word Bank

Please use these words inside the grain cart to complete the information above.



# Washington Trade Is Boosted By The Pacific Rim

Washington's location on the **Pacific Rim** allows for advantageous international trade. Canada, Japan, China, South Korea, Mexico, Philippines, Taiwan, Indonesia, Netherlands and Vietnam were Washington's top exporters in 2022. By ship, Washington ports are about two days closer than California ports to the Asian Markets. In 2022, Washington-grown or processed food and agriculture exports totaled \$8 billion (WSDA 2022). Washington consistently ranks in the top five largest exporters of food and agriculture products in the US.



## Activity

1. What is the Pacific Rim?
2. On the map, put an "X" on Washington
3. Locate on the map the top five Washington ag export countries.
4. Tell about one item that you use daily that is exported and one that is imported.
5. Tell where your items in #4 were possibly imported from and exported to.
6. Use a globe to trace the polar air routes from Washington to Europe

### 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*

## 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 14 agreements with 20 countries around the world.

## 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. In 2022, \$23 billion of food and ag products were exported through Washington Ports. Of that, \$8 billion were WA grown.

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

2022

326.7 million Americans,  
less than 1.3% on farms

# Agriculture in a Changing World

## Revolution: A "sudden or complete change"

### 1820 - 1870 Industrial Revolution in the US

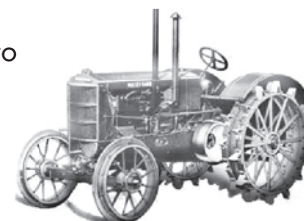
A change from hand and home production to machine and factory production



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.



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

1982 - Produced human insulin from bacteria

### 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.



# Has Technology Improved Production Agriculture?



## 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.



**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 so the grower can identify crop health and assess crop damage. Information gathered can assist with irrigation management and utilizing sensory data can determine specific harvest times.

**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.

## 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 robot that will pick apples, be adaptable and save labor costs in the long term.

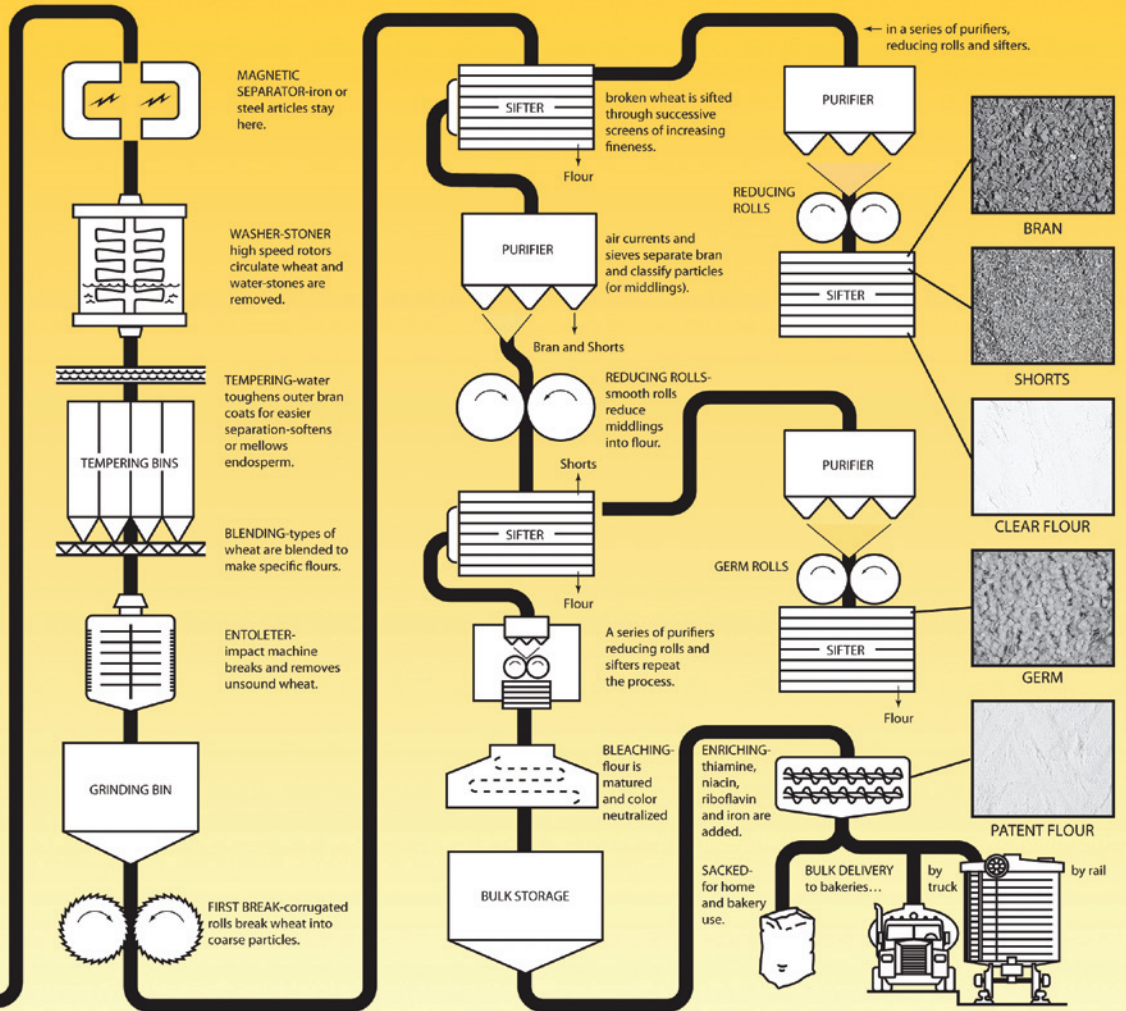
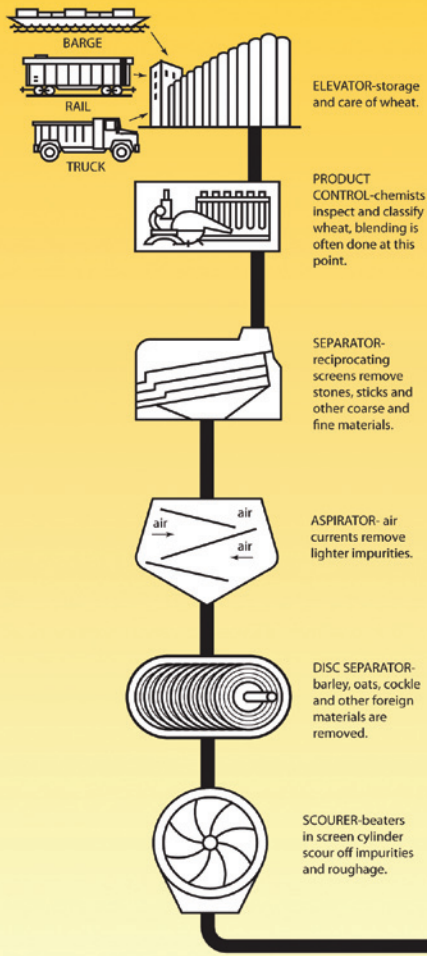
The robot features an arm and "hand" in which eight motors operate in congruence with a vision system to delicately grasp and twist the fruit off the tree as a human does.



# HOW FLOUR IS MILLED

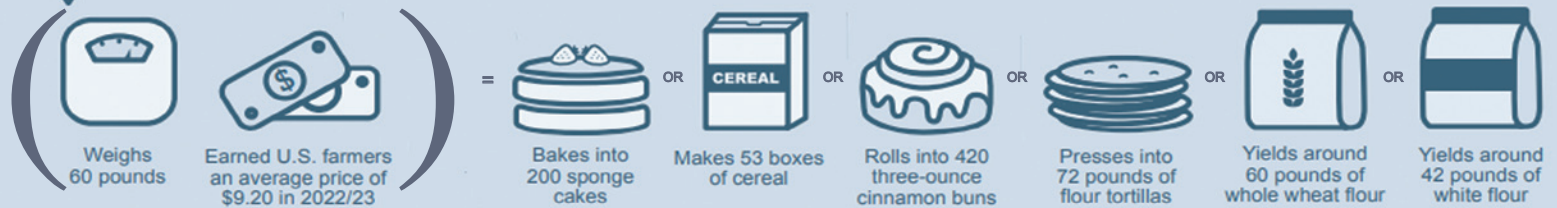
(A SIMPLIFIED DIAGRAM)

IT STARTS HERE...



NOTE: This chart is greatly simplified. The sequence, number and complexity of different operations vary in different mills.

## ONE WHEAT BUSHEL



## 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 an out-of-this-world apple was created!



Since Washington state is #1 in apple production it's only fitting that an apple be designed especially for our climate and the needs of the apple market. A group of individuals set out to do just that – have a Washington created apple that was specific to our climate, sweet in taste, firm, crisp, slow to turn brown when cut or cooked, and would last up to a year in cold storage.

Researchers, tree fruit growers, and industry partners in the state collaborated to develop and promote the **Cosmic Crisp®** WA 38 cv.—an apple that will have a “cosmic” effect on the world. The **Cosmic Crisp®** demonstrates how the science of breeding and the art of imagination can come together to make a new star apple.

**Horticulturist** Bruce Barritt and **pome** fruit breeder Kate Evans crossed Honeycrisp and Enterprise apples, taking the best parts of each—the crispy texture and sweetness from Honeycrisp, the long shelf life, durability, and color of Enterprise—and methodically repeated the breeding process for 20 years at the Washington State University (WSU) Tree Fruit Research and Extension Center in Wenatchee, Washington. Originally known as WA-38, this apple got its name from a focus group who noted that the **lenticels**—small freckles that function as pores on the skin of the apple—reminded them of constellations.

Barritt and Evans had three main requirements. First, the apple needed to be able to thrive in Washington climates. Second, the apple must be crisp and crunchy as well as have balanced sweetness and acidity. And lastly, the apple should have a long shelf life, which would make it easy to transport and reduce food waste. The apple growers of Washington took a major risk, pulling out Red Delicious apple orchards and planting 12 million **Cosmic Crisp** apple trees in their place. Washington state farmers have exclusive rights to grow **Cosmic Crisp** trees for 10 years. Premium priced and non-GMO, the **Cosmic Crisp** is the result of intense research and plant breeding that took 20 years to meet their requirements and tens of millions of dollars to produce.

“It takes a lot of time to produce a new variety,” says Evans, noting work is ongoing. “We have apple selections in every stage all the time. The bad ones are discarded, and the good ones move to the next stage of evaluation.”

Have you tried one? You can look for their cosmic appearance in the produce department of most grocery stores. Since their release a year ago they've proved to be out-of-this-world!



# Can Agriculture Continue to Feed the World?

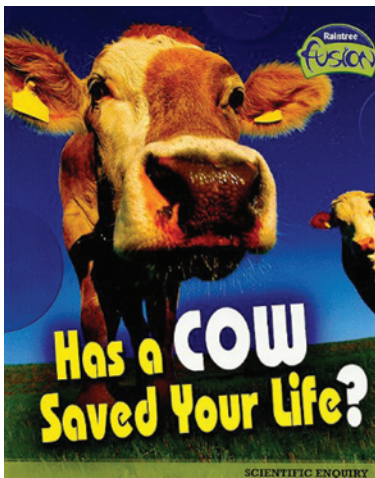


**YES! By using technology!**

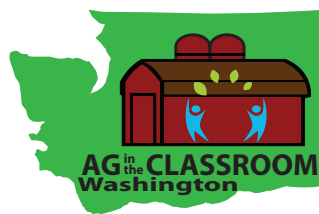
Our world population will grow to more than 9.8 billion people by 2050!  
The world's farmers & ranchers will have to grow 60% more food than what is now produced.

## LIBRARY CORNER

### Has A Cow Saved Your Life?



Millions of people are now safe from Smallpox, a deadly disease. With excellent historical color pictures this book tells the story of how the smallpox vaccine was discovered.

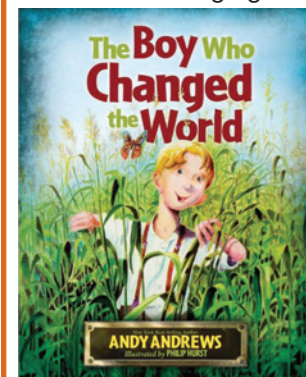


Visit Washington Ag in the Classroom at:  
[www.waic.net](http://www.waic.net)

**And like us on Facebook!**

### 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."