Ag@School TEACHER GUIDE
Volume 25, Issue 2 2025/2026

Welcome to Ag@School!

Class sets of this magazine, aimed primarily at the 4th grade level, are FREE to subscribing Washington teachers. Instructions for subscribing are on page 5. Back issues are available at www.waic.net.

This is the second of three issues for 2025-2026. Delivery of the next issue will be in April.

Produced by Washington Ag in the Classroom, Ag@School is designed to help teachers meet student educational goals as well as develop agricultural literacy.

This issue is designed to help students understand:

•High-yield agriculture has allowed us to feed the world without bringing more land into production

• Washington's location on the Pacific Rim is advantageous for international trade which fuels our state's economy

• Technology is using scientific knowledge to find a better way of doing a job

Reproducible activities in the teacher guide expand on concepts covered in the magazine. Included in the guide are instructions for a visual activity (The Earth as an Apple), vocabulary activities, answers to questions in the magazine, extended learnings and discussion questions.

Why Agricultural Literacy?

Agriculture is society's lifeline and an integral part of our heritage. Unfortunately as our country moved from agrarian to urban, people lost contact with the main industry necessary for survival—food production. America's largest industry has dropped from public discourse except for the occasional media splash. Yet we all eat, and it is important that we have an understanding of where our food is produced and who we depend upon to deliver it to our tables.

Less than 1.5% of the US population is involved in agriculture production (farming) yet 24 million American jobs are dependent upon it. Agriculture is more than working the land and tending the animals. This huge industry—production, processing, transportation, and marketing—generates billions of dollars each year. Agriculture is vital to national security, a stable economy, and the US trade balance.

Why Agriculture?

Teaching about agriculture is an ideal way for students to make real-life connections to science, math, and social studies concepts. Agriculture is relevant because students encounter it daily. Who doesn't enjoy talking about food? Nearly everything we eat, wear, use, even some fuel that powers cars and buses, comes from plants and animals grown on farms. Agriculture provides perfect real-world connections to STEM and makes learning relevant to students.

Helping students understand the farm-to-table connection is important in our consumer-driven society. Teaching students to be agriculturally literate connects their learning to everyday life.

Browse the Matrix!

Visit our website at http://www.waic.net and browse the National Ag in the Classroom link to the Curriculum Matrix

The Agricultural Literacy Curriculum Matrix is an online, searchable, and standards-based curriculum map for K-12 teachers. The Matrix contextualizes national education standards in science, social studies, and nutrition education with relevant instructional resources linked to Common Core Standards.

Search our instructional, classroom ready resources now!

Vocabulary

There are words and concepts throughout the magazine (some are **bolded**) that can be used in variety of ways to enhance learning and expansion of concepts.

technology, agrarian, urban, high-yield agriculture, dietary, Pacific Rim, supply and demand, export, import, tariffs, free trade agreements, revolution, industrial revolution, mechanical revolution, chemical revolution, Green Revolution, Electronic revolution, biotechnology revolution, electronic revolution, precision farming, GIS, GPS, drones, robotics

Standards Alignment

This publication is aligned with 4th grade standards for Washington state students

Social Studies EARLS (Essential Academic Learning Requirement)

Economics 2.1.1, 2.2.1, 2.2.2, 2.4.1

Geography 3.3.1

History 4.3.1

Common Core State Standards (CCSS)

Reading –

Questioning, Inference, and Interpretation - RI.4.1, Themes and Central Ideas –RI.4.2

Connections - - RI.4.3 , Academic Vocabulary – RI.4.4, Points of View/Purpose – RI.4.6

Visual/auditory Media and Information Sources – RI.4.7, Argument and Reasoning – RI.4.8, Fluency – RI.4.4a

Writing –

Argumentative- W.4.1b, Informative/Explanatory – W.4.2, Narrative – W.4.3,Task, Purpose and Audience –W.4.4 , Technology –W.4.6, Research – W.4.7, Access and Organize Information – W.4.8.Access and Organize information – W.4.8

Speaking and Listening –

Collaborative discussions – SL.4.1, Evaluate Presented Information – SL.4.2; SL.4.3

Language –

Language conventions – L.4.3

Reference materials – L.4.5c

Math –

Multiplication and Division - 4.NBT.B.5, Measurement – 4.MD.A.2

Science **(Next Generation Science Standards -NGSS):**

Energy 4-ESS3-1, Structure, Function and Information Processing – 4-LS1-1, Earth and Human Activity 4-ESS3, Engineering Design 3-5-ETS1-1.

Earth as an Apple

We suggest that teachers do the "Earth as an Apple" (page 6 in this guide) prior to handing out this issue. Please read the background information prior to presenting the activity.

Cover-Can Agriculture continue to feed the world?

YES! Technological change has dramatically affected agriculture, perhaps more so than any other industry. The benefits to the American consumer have been tremendous. Not only is our food less expensive, it is safe and abundant. It is produced on less land, with much less environmental impact than the subsistence farming practiced in much of the world.

Page 2 – High-Yield Agriculture

Agriculture's relationship to the economy and our standard of living is important. But, equally important is the environmental impact of modern agriculture.

World population, land-use, food demand and how extensively high-yield agriculture methods are embraced will determine what happens in the future to the remaining wild lands on the planet.

New Food Pyramid

New food pyramid guidelines can be found and explained at : *https://realfood.gov/*

Page 3 - Washington Trade is Boosted by Pacific Rim

Discussion starters

This page contains a wealth of ideas for discussion.

1. Discuss imports and exports. How are our lives changed by trade? Examine your classroom for things that were imported (look at clothing labels too). Find the countries from which they came.
2. Think of food products that we cannot grow in WA (bananas, coffee, oranges, spices). Why can't we grow these here? (climate, length of growing season, soil type). What about seasonal products that are grown here during summer (lettuce, grapes) but not in winter. How can they be offered in stores all year around? Where do they come from? How does trade with other countries (and states) benefit both parties?

4/5-Ag in a Changing World

Discussion starters:

1. Using the time line across the top of the page discuss how the US population has grown and how our society has shifted from agrarian to urban. In 1790, the US had a total population of 4 million. 90% of the population (3.6 million people) lived on farms, so our society was based on agriculture (agrarian society). In 2020, total US population was 331 million, but less than 1.3 % live on farms. The majority live in cities, thus we are now an urban society. Have students calculate the population statistics for the information given for 1850 and 1950. Which countries in the world today are considered agrarian?
2. Discuss the definition of revolution (a sudden or complete change) and how each of the revolutions listed changed the world. Introduce the phrase, "necessity is the mother of invention". What did society "need" that prompted all these inventions? What other definitions of 'revolution' do students know? (rotation of planets, or political upheaval)
3. **Note that "green revolution" has nothing to do with environmental activism.** Dr. Borlaug introduced high yielding varieties of wheat and rice that increased the amount of food produced in poor countries. What other technological improvements do we have in the US that poor countries cannot afford? (Poor farmers in developing countries cannot afford the machines we have, thus much of farming still relies on hand labor. Nor can they afford man-made fertilizers and chemicals. Diets of the people are limited in variety, quantity, and quality.)

Additional background information:

Students should note that the original John Deere plow pictured was pulled by two animals and the farmer had to walk behind to steady and guide the plow. Even the first tractors were tremendous labor savers (both in time and muscle power). As farm draft animals were replaced by machines, farmers no longer had to spend time caring for them, and could now farm the remaining fourth of farm acres that had been devoted to growing feed for the work animals.

Fertilizer bags have 3 numbers on the front, like 32-10-10. These numbers describe the percentage of Nitrogen, Phosphorus, and Potassium (in that order) contained in the bag. In this case, the 3 numbers only total 52%; the balance will be inert ingredients. Sometimes there is a fourth number given; it is usually sulphur, possibly iron; you have to read the small print to be sure. If a farmer wanted to put 20#/acre of nitrogen on his crop, how much 32-10-10 fertilizer would he need? Every pound of fertilizer would contain .32 # of nitrogen. 20#/.32 = 62.5# of 32-10-10 fertilizer.

Insulin is a protein produced in the pancreas that is essential for carbohydrate metabolism. Diabetics must inject additional insulin in order to live. Prior to biotech-bacteria producing human insulin, beef and pig pancreases were collected for insulin extraction.

All the advances in farming can be traced to developments in scientific knowledge. Individual scientists build upon the work of others, and often seemingly tiny, even unrelated discoveries can provide the "missing puzzle piece" to lead to major advancements.

Page 6 - Washington Wheat

For more information visit *https://www.wawheat.net/*

Site includes many articles, videos and information centered around Washington's wheat producing family farms.

Page 8 – Washington Dairy Farmers

For more information visit https://www.wadairy.org/

Site includes many articles, videos and information centered around Washington's dairy farms.

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

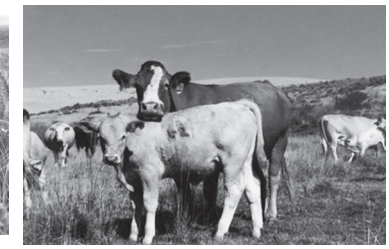
Christopher Columbus found this grain growing in North America in 1492. American Indians helped the Pilgrims survive by teaching them how to plant and cultivate it. Today, it is our country's number one agricultural crop. Iowa, Illinois, Nebraska, Minnesota and Indiana lead US production.

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.

Additional resources that have been highlighted in this issue:

https://www.fb.org/newsroom/fast-facts - fast facts about American agriculture

https://www.wagrown.com - Washington grown has a variety of information including the videos on Washington agriculture everything from A – Z!



EXPLAIN WHAT YOU LEARNED!

1. How has technology changed or improved production for farmers? Give two examples. Which innovation do you think is the most valuable? Why?
2. Persuade the reader that export trade is important to Washington. Give reasons to support your point of view.
3. Choose a job that agriculture depends upon and explain why science is an important subject to include in studies for that career.

Celebrate National Ag Day March 24th, 2026.

The National Ag Day program encourages every American to:

- Understand how food and fiber products are produced
- Value the essential role of agriculture in maintaining a strong economy.
- Appreciate the role agriculture plays in providing safe, abundant and affordable products.

Visit *www.agday.org* to see what you can do without your classroom to celebrate and recognize agriculture!

Publication and Credits

Ag@School is a publication of Washington Agriculture in the Classroom, a non-profit entity created in 1981 to encourage and help teachers increase agricultural literacy in their students. Both public and private groups including the WA Dept. of Agriculture, WSU, commodity commissions, farm organizations, agri-businesses and individuals, support this mission. Teachers may reproduce any pages for use.

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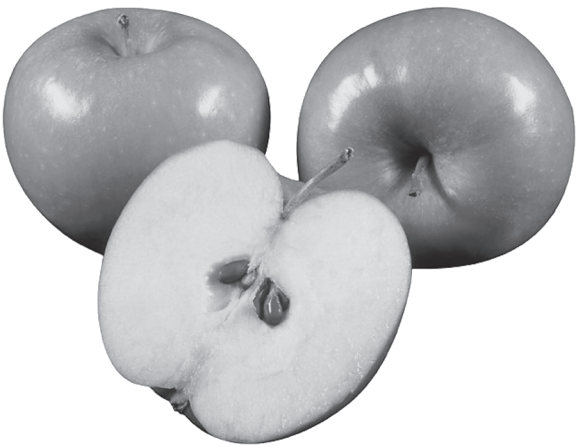
Thank you in advance for your feedback. Sorry, subscriptions are not accepted by phone

Earth as an Apple



MATERIALS REQUIRED: Large apple and paring knife

OVERVIEW: Cut an apple into smaller and smaller fractions to visually demonstrate how the earth's surface is used. All the people on earth, nearly 7 billion, live on 1/8th of the surface. Only 1/32 of the surface is now used for growing food.

OBJECTIVE: Understanding why high-yield agriculture (growing more on less land) is necessary to avoid plowing more land to feed a growing population demanding better food.

Explain that the apple represents the earth

Cut apple into four quarters:

- Three of those represent the oceans. Set those 3 quarters aside
- Remaining quarter represents total land area of planet.

Cut the land quarter into two pieces:

- One piece (1/8) is inhospitable to people. People can't live there. It includes polar regions, deserts, swamps, and very high or rocky mountains. Set it aside.
- Remaining 1/8 is land where all the people live, nearly 7 billion.

Cut the 1/8 where people live into four pieces (4/32nds):

Three of these are land that does not grow food.

- Land that is too wet, too dry, too cold, too steep, or the soil is too poor.
- Land covered by cities, shopping centers, freeways, and all the things we have built on the earth.
- Land now used for other things like parks, rainforest, wildlife habitat, wetlands and recreation areas.

Set those 3 sections aside.

Carefully peel the last 1/32 slice:

- This tiny bit of peeling represents the topsoil, the thin skin of the earth's crust upon which man depends.
- Less than 5 feet thick, it is a very fixed amount of food-producing land

Discussion Ideas and Background

1) Is earth's population going up or down? Why?

World wide birth rates are dropping but death rates are also dropping. Population is rising because more babies live to grow up and they are living longer – better medicines, improved sanitation and disease control.

2) Is the amount of land available for growing food increasing or decreasing?

In developed countries agricultural land is decreasing as ecologically sensitive land is taken out of production and more land is used for urbanization. However, production has increased more than enough to offset the difference. The US has tripled production on the same amount of farmland.

In poor countries, agricultural land is expanding as populations grow and people can afford better diets. Lacking modern technology, their only way to increase production is to use more land. Since the best land was already being farmed, the additional land is coming from marginal, mostly tropical areas that contain most of the planet's biodiversity.

3) Brainstorming ideas for growing more food without increasing land use? (diets must also improve)

High-yield agriculture (growing more food on less land) is very successful in developed countries due to use of chemical fertilizers, pesticides, biotechnology, and irrigation. Exports by US farmers save millions of acres of land from being plowed someplace else.

In spite of this success, modern farming inputs are often controversial in wealthy nations. They are not controversial in poor countries because the increased yeilds are so desperately needed. But, due to cost, they are rarely available to poor subsistence farmers.

Biotechnology: genetically improved crops can be engineered to grow in harsh conditions. These might include crops that require less water, crops that will grow in saline (salty) soils, or crops that are resistant to fungi that cause plant diseases.

Pest and plant disease control: Without pest control, an estimated 70% of the worlds crops would be lost each year. To offset the loss in production, at least 90% more cropland would be required (the additional land will have lower production). Pesticides do occasionally show up in places they aren't supposed to be. However, without chemicals, those places would likely not even exist. They would already be farmed for food. Perhaps in the future, genetic engineering will replace the need for pesticides. But, at this point in time, the world cannot spare enough land to farm without them.

More efficient use of water: Water for agriculture is a problem for some aquatic species. However, irrigation triples the productivity of the land. If irrigation were stopped, another 1,310,000,000 (1.31 billion) acres of land would have to be farmed to make up the lost production. The solution is not to quit irrigating; it is to make better use of the water.