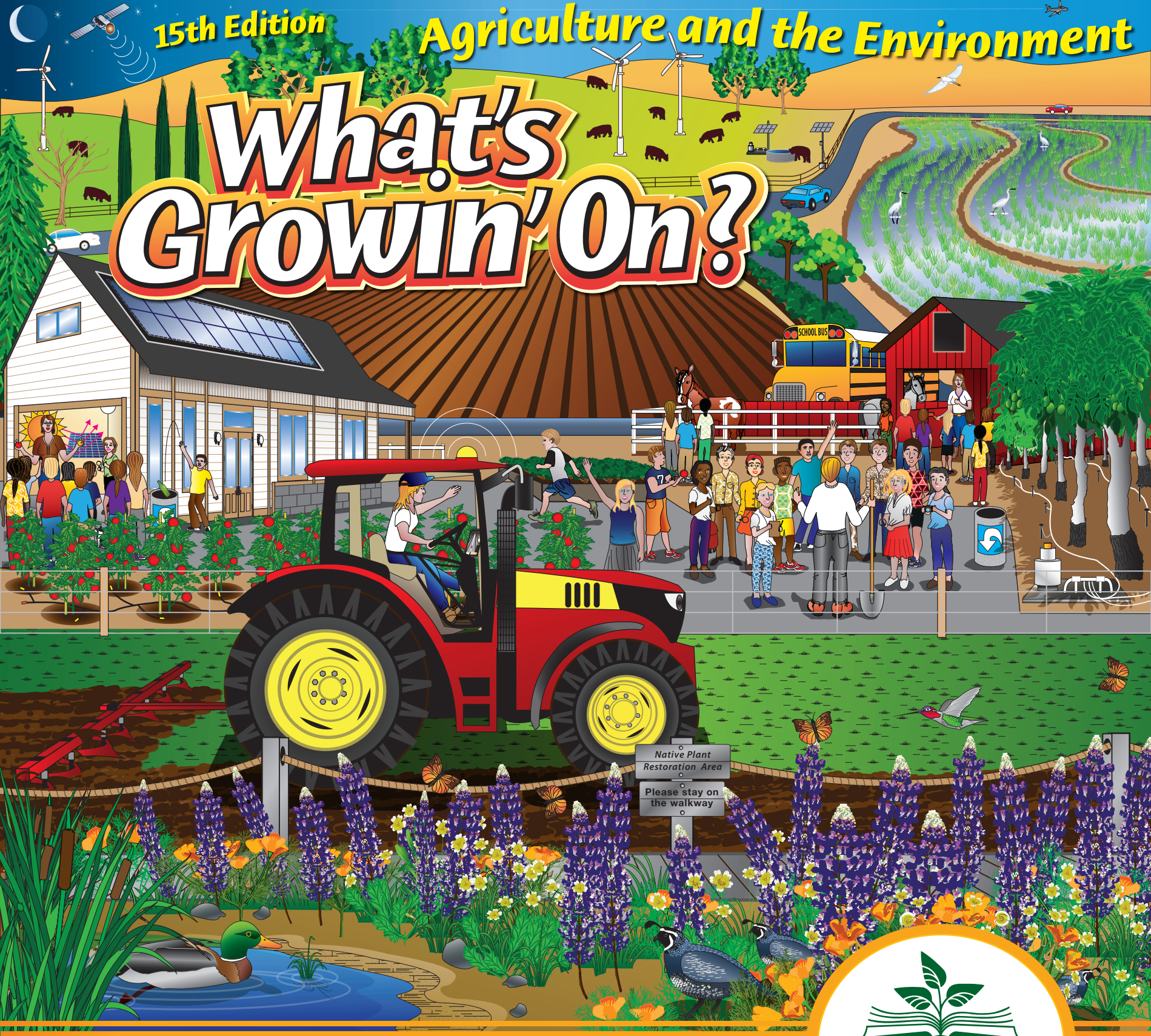
15th Edition

Agriculture and the Environment

What's Growin' On?



NEWSPAPERS IN EDUCATION

For Extra! Extra! Classroom Extensions, visit LearnAboutAg.org/wgo or call (800) 700-AITC.

California Foundation for Agriculture in the Classroom

A Message for Everyone

Sustainability is a key concept in this year's edition of *What's Growin' On? Agriculture and the Environment*. What is Sustainability? To put it simply, it's raising food and fiber while protecting the environment, people, and the economy. There is a close connection between farming and protecting the natural resources of the earth that are the foundation of agriculture.

California farmers have cared for the environment for many generations. Today, they provide habitat for wildlife and conserve natural resources through innovative farming practices and new technologies. They not only provide us with food and fiber, but manage wildlife, practice conservation, compost and recycle!

Sustainability of agriculture and the environment is not only for farmers but for everyone - through education, innovative solutions and working together to make our communities a better place to live. Let's all make sure our soil, water, and air remain fertile, safe and productive so we can be assured of the freshest, safest, and healthiest food in the world now and for future generations.

Read on to find out how farmers are leading the way, using new innovations to produce their harvest while sustaining the quality of the limited natural resources we are so fortunate to have in California. Find out how you can become a part of sustainability and innovation by trying out the Citizen Science and Service Learning activities in this issue.

Table of Contents

A Message for Teachers

It's important to consider that our world population could potentially double by the end of this century and we'll need to be creative in how to manage that – more people, more food, limited land, limited resources. There are many challenges that face all of us. Learning how farmers use new innovations to grow food and sustain the natural environment is a great start to becoming informed. Being informed can help students make decisions about how they will take care of themselves, their families, and the world we all live in.

This issue of *What's Growin' On?* can be a great start to introducing California's Environmental Principles and Concepts (EP&C's) into the classroom. These concepts will soon be part of all California textbooks and instructional materials. To learn more about California's EP&C's, visit www.californiaeei.org/abouteei/whatistaught/epc.

Happy Reading!

SHARE YOUR PHOTOS AND PROJECT STORIES Via Facebook, Twitter and Instagram! Include @LearnAboutAg in your posts and use the hashtags #AgServeAndLearn and #AgCitizenScience.

Look for Citizen Science Projects throughout this issue!

Citizen Science projects are a collaboration between the public and scientists. Students participate in observing, collecting data, and contributing their findings on a variety of projects. Feel free to search for or even create your own class Citizen Science project.

Look for Service Learning Projects throughout this issue!

Service Learning is a strategy that incorporates community service projects with instruction and reflection. Its goal is to teach community responsibility while strengthening local communities. Feel free to develop your own Service Learning project that will benefit your school and community.

Look for Newspaper in Education (NIE) activities throughout this issue!

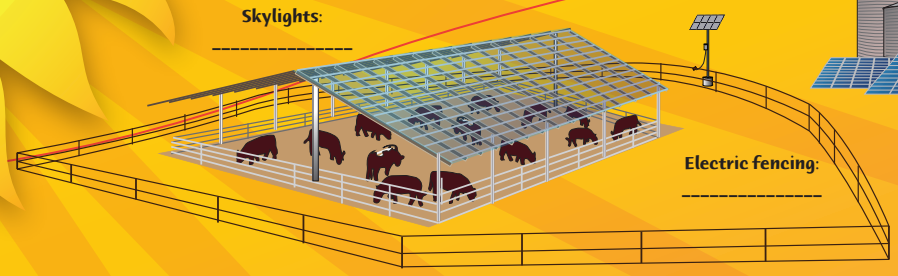
Students are encouraged to read the newspaper and challenge themselves with creative extension activities.

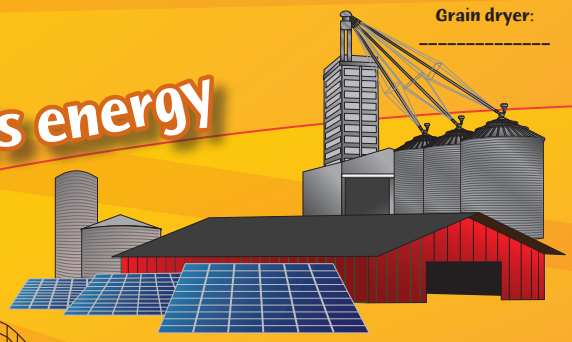
Vocabulary words are highlighted in dark red throughout the issue. Look for them in the glossary.

- *The sun delivers more energy to the earth in just one hour than is currently used worldwide in a year.*
- *Farmers use the sun's natural energy in many innovative ways.*

Sun Power

Harvesting the sun's energy





The sun is #1 and farmers know this as well as anyone! Without it we couldn't grow food, wouldn't have rain, and our earth wouldn't be warm enough for us to live here! Why is that? The sun's energy allows plants to create their own food through photosynthesis. Heat from the sun warms air masses that affect weather such as rain. Solar heat also warms our oceans and keeps earth from being an ice-covered rock!

How do farmers use solar energy?

Farmers have naturally used solar energy forever. Leaving cut hay, such as alfalfa, to dry in the field is an example of using the sun's energy.

What is solar energy?

Energy in the sun's rays can be converted into heat and electricity. There are two types of solar energy: passive and active.

- **Passive Solar Energy:** Does not use solar panels, uses the direction of the sun, building orientation, and insulating materials. Captures the energy by south-facing windows, large overhangs, and building color. A greenhouse uses passive solar energy.
- **Active Solar Energy:** Uses solar panels to collect sunlight and convert that energy into electrical energy. Solar panels can be near equipment needing electricity such as irrigation pumps. Check out the front cover of this paper for an example.

Why use solar power?

- Naturally, the sun's heat is used to light and warm buildings by capturing light through skylights and absorbing heat through building color.
- Using solar-powered dryers can dry crops and grains faster and more evenly, while avoiding damage from birds, pests, and weather.
- In areas without electric line access, photovoltaic (PV) panels provide a remote electrical supply for electric fences, lights, and pumps.

Solar Oven Activity

Trap some of the sun's energy and make your own solar oven! Try making s'mores, nachos, or even boiling water. Check out climatekids.nasa.gov/smores for ideas.

Challenge Complete the chart of the pros and cons of solar energy uses. Have a debate about why or why not to use solar.

pros	cons
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

How do solar panels work? Solar panels contain solar cells that capture sunlight and hold in the energy until it's converted into electrical energy. In contrast, plants capture sunlight, hold it in, and use the energy to convert CO_2 (carbon dioxide) and H_2O (water) into $C_6H_{12}O_6$ (sugar) and O_2 (oxygen) - a process called _____.

Activity

Find 9 examples of solar energy on this page, label ACTIVE or PASSIVE. Think of other ways farmers and YOU use solar energy; add your ideas to the page and label.

ANSWERS:
Active: Remote pump, Electric fencing, Solar panels, Grain dryer.
Passive: Skylights, greenhouse, Solar oven, Sun-dried raisins, Alfalfa drying.

Service Learning

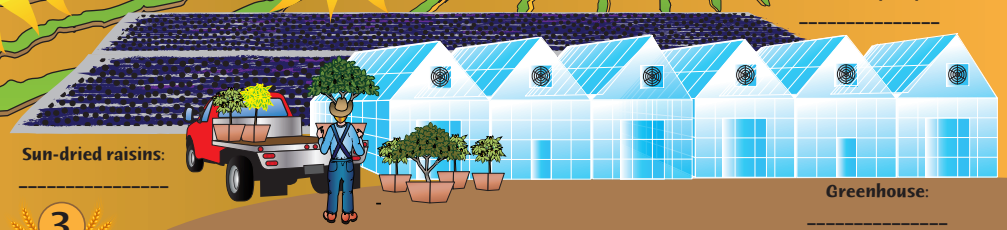
Do a school energy audit. Go to Green Schools Initiative at: www.greenschools.net/form.php-modin=53.html

N.I.E.

Check out ads for solar energy panels. Make your own ad to sell the benefits of using solar power.

Did you Know?

Greenhouse walls are insulated - reducing heat loss at night and heat gain during the day!



CA Standards: ELA CCSS: RI.3-8.1, W.3-8.1, 4, SL.3.4, SL.4-8.4, 5, RST.3-8.7; NGSS: 4-ESS3-1, 2, 5-ESS3-1
Sources: harec.ucanr.edu; sandia.gov; ucsusa.org; extension.purdue.edu/extmedia/ae/ae-108.html; climatekids.nasa.gov/menu/energy

Blowin' in the Wind

Did you know?
Wind energy is an example of kinetic energy, the energy of motion. The wind causes turbines to move, which creates energy that can be converted to electricity!

How Farmers Help Keep the Air Clean

Clean air is important to agriculture. Pollution can cause losses in crop yields. Today, farmers use cleaner-burning tractors and equipment, plant windbreaks for dust control and plant trees that provide oxygen. California agriculture is a major contributor to clean air! Farmers use many conservation practices to decrease pollution. Decide and label which category of air pollution they are helping decrease: SMOKE, DUST, ODOR, OR GROUND-LEVEL OZONE.

N.I.E.
Check the newspaper for daily AQI information or go online at www.airnow.gov. Keep daily, weekly or school year AQI results for your town. Use data to create a graph to show the results. Challenge: Compare the world's largest cities and their AQI for a day.

1. **Rice straw:** It can be harvested and manufactured into fiberboard, bricks, or paper pulp. It can also be used for livestock feed, energy generation, soil erosion prevention, or waterfowl habitat. _____

2. **More efficient engines:** Farmers can participate in programs like the California Air Resources Board's (ARB) Carl Moyer program to replace old engines with lower-**emitting** equipment. _____

3. **Wind breaks:** Planting trees and **hedgerows** for wind breaks reduces soil erosion and blocks dust, lowers temperature, creates habitat, and takes in CO_2. _____

4. **Mulch:** Crop waste, orchard and vineyard prunings are chipped and shredded. These are then left on top of the soil or incorporated into the soil. _____

5. **Anaerobic Digesters:** Dairy digesters capture cow manure's methane gas and convert it to useable energy and fuel for the dairy farm, homes, and businesses. _____

6. **Controlled burning:** Only allowed on burn days as designated by the local air pollution control district or local fire department. _____

ANSWERS: 1. Smoke, 2. Ground-level ozone, 3. Dust, 4. Dust, 5. Odor, 6. Smoke

Did you know?
Forestry is considered agriculture and California has approximately 33 million acres of forest.

Trees work as natural filters and can help reduce smog. In one year, an acre of mature trees absorbs the amount of CO_2 produced by a car driven 26,000 miles!

California has more than one-million acres of almond orchards!

Service Learning
Did you know one large tree can provide a day's supply of oxygen for up to four people? Learn all sorts of things about trees and organize a tree planting project with your school or community. Visit www.arborday.org for information and ideas.

What is in our Air?

We all notice smells in the air. Think about how it smells when something delicious is cooking in the kitchen or when there is smoke in the air! Wind moves the air which can pick up dust, pollens, and other substances causing allergy problems for many! Odors, dust, smoke, and ground-level ozone are all part of the air that we breathe.

What is Air Pollution?

Air pollution can harm living organisms, damage structures, or cause nuisances such as odor or reduced visibility. Odors, dust, smoke and ground-level ozone all make up air pollution. The Air Quality Index (AQI) is a number used to communicate how polluted the air is.

Air Quality Index (AQI) Chart

Go to www.sparetheair.com/aqi.cfm for information to complete the chart

Range	Level	Color	What Colors Mean
0 - 50	Good		Air pollution poses no or little risk
51 – 100			
	Moderate	Yellow	
101 - 150	Unhealthy for Sensitive Groups		
151 – 200		Red	
	Very Unhealthy		Affects those with serious health issues
	Hazardous	Maroon	

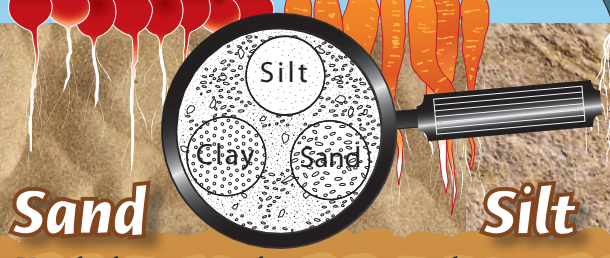
Check out this Carbon Footprint Calculator: coolcalifornia.org/calculator-households-individuals

CA Standards: ELA CC: W.3-8.7, 8, SL.3-8.4; Math CC: 3.MD.3, 4.MD.4, 5.MD.2; NGSS: 3-ESS2-1, 2, 3-ESS3-1, 4-ESS3-1, 5-ESS3-1
Sources: www.sparetheair.com/aqi.cfm; www.caaqes.tamu.edu; www.arb.ca.gov; www.energy.ca.gov/wind/overview.html.

Digging into Soil!

Life on earth depends on soil; it is the primary source of food, feed, fuel, forage and fiber. It is considered a non-renewable resource - we have to take care of it, we can never replace it!

Soil Types



Sand

Has the largest particle size among soil types and it's dry and gritty to the touch. It doesn't hold water as well as other soil types. Plants that can grow in sandy soils include carrots, radishes, and asparagus.

Silt

Has a medium particle size. When moistened, it's slick. It compacts easily and retains water longer than sand. Plants that can grow in silty soils are trees, flowers, and tomatoes.

Clay

Has the smallest particle size of the three soil types (sand, silt, clay). It's sticky to touch when wet, smooth when dry. Plants that can grow well include broccoli, brussel sprouts, kale and cabbage.

Loam

Is ideal for gardening and farming. It is a combination of all three soil types (sand, silt, clay) plus humus (organic matter). It holds water well and is soft, dry and crumbly in your hands.

Activity

SOIL SCIENCE: Collect two soil samples from school or home. With the descriptions above, determine which type of soil you have.
CHALLENGE: Put your soil in a jar, add water, close the lid, shake and leave overnight. In the morning, you'll see soil layers. Sand settles to the bottom, silt in the middle, and clay at top. Estimate the percentage of each soil type in your soil and then create a graph to show your estimates.

California Farmers conserve soil!

California farmers use sustainable methods to improve the quality of the soil, minimize erosion and prevent other losses of soil.

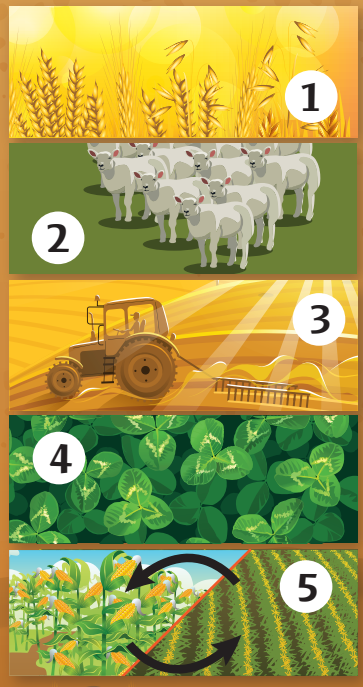
1. Minimize Erosion: Farmers plant trees and grasses which can help hold soil in place as well as provide a wind break. Contour farming uses the natural contours of the land to slow water runoff.

2. Rotational Grazing: Farmers move livestock often to prevent overgrazing of pasture and rangeland. Hooves can aerate the soil by breaking the crust and allowing for better water penetration.

3. Reduced Tillage: Farmers reduce the number of tractor passes across their field and allow grasses and vegetation to remain in place after harvest. This helps prevent soil from blowing or being washed away.

4. Cover Crops: Farmers plant cover crops, such as clover, which can add nitrogen back into the soil and also "cover" the soil - protecting it from wind and water erosion.

5. Crop Rotation: Changing or "rotating" crops in the same field each season ensures that the soil is not depleted of certain nutrients. It also helps reduce soil erosion and increase soil fertility and crop yield.



SERVICE LEARNING
Start a composting project in your backyard or school garden. Read about how composting can benefit your school and community. Check out cwmi.css.cornell.edu/composting.htm for composting information.

DID YOU KNOW?
Alfalfa has many benefits for soil. It is a fertilizer, naturally adding nitrogen to the soil! It's also a perennial crop, staying in the ground for 4-6 years. It improves drainage, moisture content, and aeration of soil . In addition, it hosts many beneficial insects such as lady beetles and provides habitat for wildlife such as the Swainson's Hawk.

Erosion Activity

Erosion is a process where the surface of the Earth gets worn down or washed away. Walk the school yard and look for signs of erosion. Discuss causes and measures to reduce erosion.

CA Standards: ELA CC: RI.3-5.1, 3, 7; RI.6-8.7; W.3-5.7, 8; SL.3-8.1; WHST.6-8.7, 8; NGSS: 3-LS4-4, 3-ESS3-1; 4-ESS1-1, 4-ESS2-1, 2; 5-ESS2-1, 5-ESS3-1; MS-LS2-1, MS-ESS2-2, MS-ESS3-3
Sources: ceventura.ucanr.edu/Com_Ag/Soils; Sonoma-county.org/agcomm/pdf/bmp_handbook3.pdf

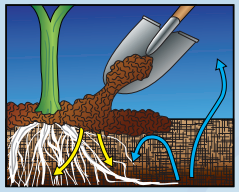
Water Innovations

What is agriculture doing to use water more efficiently?

Manage Soil | **Manage Plants & Livestock** | **Direct Capture Reuse**

By taking care of the soil, managing plants and livestock, and using innovative ways to direct, capture, and reuse water, farmers are making a difference in the amount of water they use.

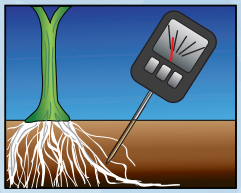
Compost & Mulch: Organic matter holds moisture in.



Conservation Tillage: No tilling or reduced tilling slows or limits evaporation from soil.

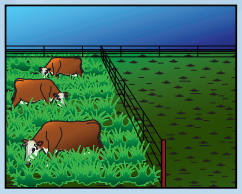
Healthy Soil: Holds water by acting like a sponge.

Irrigation Scheduling: Determines moisture needs of plants and soil.

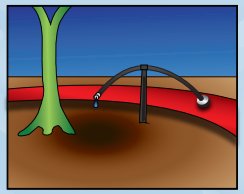


Cover Crops: Allow better water penetration and soil moisture retention.

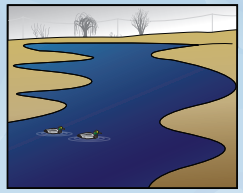
Rotational Grazing: Increases water absorption and decreases run off.



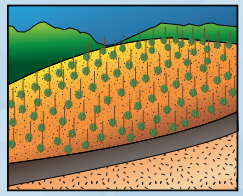
Drip Irrigation: Waters directly to the roots, reducing evaporation.



Capture Water: Ponds store water, provide animal habitat, and recharge groundwater.



Dry Farming: No irrigation, relies on moisture in the soil.



Activity Investigate and find examples of methods that use water more efficiently in your school or community. Add to the boxes below.

Manage Soil	Manage Plants & Livestock	Direct, Capture, Reuse

Did you Know?
California flower farmers use eco-friendly practices! 100% of all water used in hydroponic growing is reclaimed and recycled.

N.I.E.
Look in your local paper, or online, for articles about agriculture water use. Write a summary and report to your class. Don't forget to cite your source.

Citizen Science
World Water Monitoring Challenge - Citizen Scientists test the quality of their waterways, share their findings, and protect our precious resource. To learn more go to scientificamerican.com/citizen-science/world-water-monitoring-challenge.

California Farmers have to make every drop count

There are many innovative water projects going on in California. Check out agwaterstewards.org to learn more.

Recycled Water Project: Recycled water can be used for food crops, parks, schools, golf courses, and landscapes. The Los Carneros Water District Project in Napa, uses recycled sewer water and pipes it to landowners for irrigating their vineyards and landscapes.

Math Activity: If it costs $1.57 per 1,000 gallons to purchase recycled water, how much does 100 gallons cost? 5,000 gallons? What about an acre-foot of water? Hint: An acre-foot of water is 325,851 gallons.

ANSWER: $0.157 cost, $7.85 cost, $511.59 cost

DID YOU KNOW?
California's developed water supply is used as follows: 50.1% to the Environment, 40.8% to Agriculture, and the remaining to Urban use. Create a pie chart by showing the correct percentage of water used in each of these three areas. Don't forget to label your graph.

Floating Farms?

What is it? Is it plausible? Research floating farms online and then design your own floating farm, show it to your class! Discuss the pros and cons of why it might or might not be a good idea and if it could work - then have a class debate!

CA Standards: ELA CC: RI.3-6.1, 2, 3, 4, 5, 7; RI.7-8.1, 4; W.3-8.2, 6, 7, 8; SL.3-8.1, 4; Math CC: 3.OA.7; 4.OA.2; 5.NBT.1; NGSS: 3-LS4-4; 4-ESS2-1, 4-ESS3-2; 5-ESS3-1; MS-ESS3-3

Sources: californiawateralliance.org/resources, agwaterstewards.org, California Water Plan: update 2013, ppic.org/main/publication_show.asp?i=1108, plantingseedsblog.cdfa.ca.gov, www.water.ca.gov, www.cuesa.org/article/10-ways-farmers-are-saving-water

Journey on the Climate Trail

It's clear that Earth's climate is changing and many scientists tell us our planet is warming up due to human activity. So the big question is… how do we all live sustainably on Planet Earth? Embark on a journey to learn about climate change, contributing factors, renewable energy resources, *what AGRICULTURE is doing, and what YOU can do* to reduce your carbon footprint.

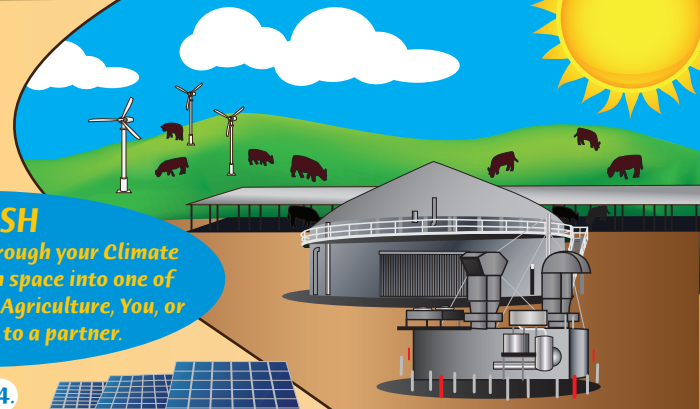
Good luck!

1. START

Move through the spaces one at a time and answer all of the questions. Work individually, or with a partner or small group.

15. FINISH

Now that you've gone through your Climate Journey, categorize each space into one of the following categories: Agriculture, You, or Earth. Explain why to a partner.



Citizen Science Participate in a climate project - go to scistarter.com and search "climate." Extension: With your class, graph weather data for a 12-hour period anywhere in the United States. Use the National Weather Service site at www.weather.gov to gather your data and create graphs. Finally, using the graphs you make, share the temperatures for the same 12-hour period at locations across the USA.

2. Climate vs. Weather:

What's the difference? Climate is the average weather in a place over a period of time. Weather is the wind, rain, clouds, and temperature in our atmosphere over a short period of time. Name an example of each.

_____

_____

(Weather: It's 95 degrees today or it's raining and windy today. Climate: The central coast of CA has mild winters and cool summers.)

3. Climate Change:

Climate change is a significant change in the Earth's climate. What is a way you've seen or heard about our climate changing? Find an example and share.

_____

(Examples include from your class, the news, online, or a local paper)

4. Global Warming:

Global warming is an increase in temperature near the surface of the Earth that may be caused by people's activities. What could some of these activities be?

_____

(Examples could include driving cars, generating and using electricity, factories and forest fires.)

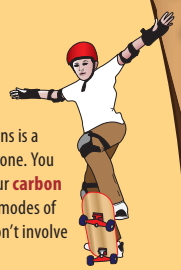
5. AB 32 and SB 32:

The state of California raises the bar when it comes to a sustainable, low-carbon future. A California law, called the California Global Warming Solutions Act of 2006, aims to reduce **greenhouse gas (GHG)** emissions to year 1990 levels by year 2020. The goals of AB 32 were extended in 2016 by SB 32. Look online for the laws. Find out what AB and SB mean and name two greenhouse gases. Share with a partner.

_____

(Assembly Bill 32, Senate Bill 32, Carbon dioxide and Methane)

6. Vehicle Usage:



Reducing GHG emissions is a responsibility of everyone. You can help! Decrease your **carbon footprint.** List three modes of transportation that don't involve a car.

_____

_____

_____

(Walking, biking, train, subway, bus, etc.)

7. Appliances:

Decreasing GHG emissions and minimizing your carbon footprint goes beyond vehicle usage. Turn off your lights and appliances when you are not using them. Name two appliances that you can turn off when you're not using them. _____

_____

_____

(Television, computer, phone charger, etc.)

8. Heating & Air Systems:

Adjust your thermostat to 68 degrees F in the winter and 78 degrees F in the summer. Turn down or turn off your controlled air system when you are away to save energy. Beyond adjusting your thermostat, what else can you do to keep warmer in the winter?

_____

_____

(Close doors and windows, wear a sweater, slippers, etc.)

9. Hot Water Usage:

The process of heating water utilizes a lot of energy. How does this relate to you? Shorten your hot showers and use the "cold" water setting on your washing machine. Research and share the temperature your water heater should be set at so the water never gets unnecessarily hot.

_____

(120 degrees F)

10. Reduce, Reuse, Recycle… and Compost:

Do you recycle your glass, paper, and plastic at home? School? Do you compost yard waste and food scraps at home? School? Think about how you can reduce or reuse items at home. Write and share your answers with a classmate.

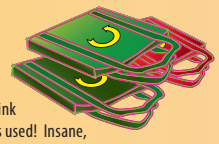
_____

_____

_____

(Possible answers: collect and turn in recyclables, create a compost pile at home or school to use in your garden)

11. Less Packaging:



Consider toys, food, electronics, and other items that your family purchases. Think about how much packaging is used! Insane, right? To reduce the amount used, consider buying in bulk and utilizing reusable shopping bags. How many reusable shopping bags does your family have? Where do you store them? Share with your classmate. _____

_____

_____

12. Agricultural Climates:

Where in CA does your food come from? We need different climates to grow different crops. Grapes grow best in warm summers and mild winters. Almonds grow best in wet, cold winters, and hot, dry summers. Lettuce grows best in humid, frost-free areas and Citrus grows best in warm summers and mild winters. Knowing these different climates, where would you find each of these crops? Look online at LearnAboutAg.org/resources/learn/map.pdf to find out!

_____

_____

_____

_____

_____

(Possible answers: Grapes- Sonoma, Napa; Almonds: Colusa, Fresno; Lettuce: Monterey, San Benito; Citrus: Tulare, Ventura)

13. Effects on Agriculture:

Agriculture could be affected by climate change in a number of ways. Higher temps cause crops to grow too quickly and yield less or increases in water temp can affect fish. Droughts and floods can also affect crop yields and many weeds and pests thrive under warmer, wetter climates. Heat waves can affect the livestock industry and animal feed supplies can be affected. Can you think of other ways? **How might this affect YOU?** _____

_____

_____

_____

14. Agricultural Solutions:

Agriculture uses renewable energy such as Solar energy, **Kinetic** energy and **Methane Digesters.** Review the sun, air, and animal pages. Which renewable energy do you think is best? Why? _____

_____

(Examples: Solar- provides an abundant supply of light and heat energy, CA is an excellent location to take advantage of the sun's energy; Kinetic – for locations that are remote and have lots of wind, this can be a good choice; Methane Digesters - utilize animal manure and convert it to useable gas, would be best near animal production areas.)

Did you know?

If we didn't have any greenhouse gases our planet would be all ice? Go to Climate Kids: NASA's Eyes on the Earth at climatekids.nasa.gov to find out more.

Did you Know? Have you heard of bioplastics packaging? Bioplastics are compostable plastics derived from biomass (once-living) sources rather than plastics made from petroleum products. Go to www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=141 and try making your own bioplastic from corn!

CA Standards: ELA CC: RI.3-5.1, 3, 4, 5, 7, 10; RI.6-8.1, 2, 3, 4; W.3-8.7 8; SL.3-8.1, 4; Math CC: 3.MD.3; 4.MD.4; 5.MD.2; NGSS: 3-ESS2-1, 2; 4-ESS3-1, 2; 5-ESS3-1; MS-ESS3-3, 5

Sources: usda.gov/wps/portal/usda/usdahome?navid=climate-change; energy.gov/energysaver; www.epa.gov/climate-impacts/climate-impacts-agriculture-and-food-supply

What is technology? Technology is any tool, equipment, or machinery that is developed to solve a problem and make life better, easier and safer!

Technology Ties It All Together!

As you can see, the technologies that are used in agriculture have come a long way! Precision farming has helped farmers improve their crops and how they take care of the natural resources of the land. What do you think is next?

Farmers don't wear overalls or chew on straw! Farmers of today are men and women who have college degrees or vocational training, are business managers, and use the newest technologies to make their farming operations successful. Read on to see how farming started and what equipment and technologies have been used throughout history. Learn how today's farmers use smart phones, drones, and GPS! Finally, look forward with us, imagining what technologies are yet to come to produce the best quality food in the world, while taking care of the natural environment!

Past Technologies

- **5,000 years ago:** Ancient Egyptians farmed the fertile soil around the Nile and used wooden tools such as a plow pulled by oxen.
- **1800s**: Farmers worked their fields with horse-drawn **implements**, such as plows.
- **1900s:** First gas-powered tractors became available, allowing farmers to work their fields more efficiently. By the 1950s, there were more tractors than horses on farms!
- **1990s**: **Information technology** and precision techniques greatly improved farm production. These innovations included – data collection, farm planning, mapping, soil sampling, yield monitoring, and higher crop efficiency.

Did You Know? A hundred years ago, it would take a farmer with two horses more than 15 days to plow 40 acres. With a tractor, the same 40 acres could be plowed in one day! Horsepower is a term still used today to describe the amount of potential power an engine has.

Activity - Tractor Timeline

THERE IS SO MUCH MORE TO THE STORY!
Research and find more inventions in farming equipment that advanced agriculture. Create a timeline – include dates, facts, and drawings.
To get started, find out what invention was patented in 1794 and list here:
_____
(Answer: Eli Whitney's cotton gin revolutionized production of cotton by removing seeds from cotton quickly)

Today - Precision Farming

Since the early 2000s, technology has taken off! There are many innovations that increase farming efficiency - called Precision Farming. Check out these three examples:

1. SMART PHONE APPS

- **CropManage:** Helps farmers to accurately apply fertilizer to their crops. Check out the following link to learn more about this app and other current research: **www.morningagclips.com/improvement-in-nitrogen-assessment**.
- **Distance and Area:** The farmer walks or drives around a field while the app measures its area and determines the acreage.

Activity - Map & Measure

Draw your classroom or school on a piece of paper, then using a ruler, tape measure, or foot-step, measure the length and width. Find the perimeter and area (perimeter = length of all sides and area = length x width). Try other areas of your school – the garden, the playground, the track, etc.
Perimeter: _____
Area: _____

Challenge: Did you know in the middle ages an acre was defined as the amount of land that could be plowed in one day by one man and an ox? How many square feet are in an acre? _____
(ANSWER: 43,560 square feet)

How many acres is a field that is 1,000 feet by 1,000 feet? _____
(ANSWER: 2.296 acres, 1,000 x 1,000 = 1,000,000/ 43,560)

How many acres is your school? _____

Activity - Tech Check!

What do a fork, a chair, a tractor, and a computer all have in common? They are all examples of technology! Make a list of other technologies you use throughout the day: _____
_____
_____

How many did you think of? _____
Count all the technologies used on this page and throughout this issue and list them. Did you know so many tools were used for Ag?
_____
_____
_____
_____

Check out this video at: www.youtube.com/watch?v=Giiz81_uzK8

2. DRONES

Farmer Ryan Schohr (pictured) says the "toolbox of technology" helps his farming operation be more sustainable, economically and environmentally. He uses a drone to help identify areas in his fields that need more attention, for example better weed control. He uses smartphone apps to monitor the weather and opportunities for selling his crops. "Technology, and the data it provides, is a critical part of farming, and is becoming a more and more valuable resource on our farm."

Farmer Ryan Schohr

3. GLOBAL POSITIONING SYSTEM (GPS)

You may be familiar with a GPS system from your car or phone, but farmers use GPS systems in their tractors. The tractor's GPS receives satellite signals which determine the precise location of the tractor - within yards! GPS technology has allowed for accuracy in spacing between rows, mapping of fields, harvesting, planting, and fertilizing crops. It also allows farmers to work during limited visibility such as fog and darkness. This precision information reduces fuel use, saves time, and provides accurate feedback on what plants need - such as fertilizer requirements and water needs. Check out **www.cropscience.bayer.com/en/stories/2014/digital-farming-bit-by-bit** to see how ag machinery such as tractors, combines, and sprayers can be tracked via satellite. Sensors collect data on plant health, harvest yield, and soil composition.

Future Innovations

Challenge: **The world's population will top nine billion people by 2050, how will we feed the world? In the empty frame provided above, draw your own agricultural invention. Explain how it will work and how it will solve this future challenge.**
_____
_____
_____

Did You Know?
- **Currently, there is a shortage of US college graduates with a degree in agriculture.**
- **Across the world, 1 in 3 people work in agriculture.**

Citizen Science

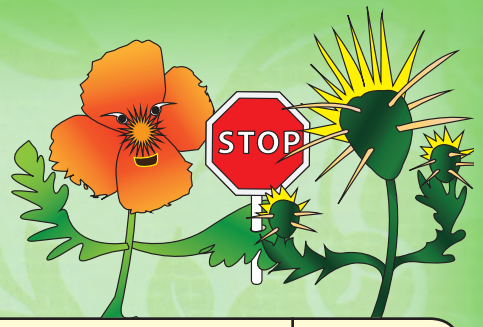
Now that you're an expert on citizen science and have learned about different challenges farmers face, create your own "App for Ag" citizen science project. What will it do? How will it help? Think about the different challenges farmers face and use your creativity to develop an app idea. Draw your app icon and write a brief summary of what it will accomplish. Check out www.apps-for-ag.com to find out what recent apps have been developed.

N.I.E.

Create a Time Capsule! Cut photos and articles from the newspaper about environmental issues. Include land use, water availability, or any topic related to agriculture. Do your own or have everyone in your class contribute. Write a letter to include in the time capsule. Explain why you are including the photos and articles. Map out your school, and draw in the location where you would bury your time capsule. Present your time capsule to your class.

CA Standards: CCSS ELA: RI.3-5.1, 2, 3, 7; W.3-8.4, 7, 8; RH.6-8.5, 7; RST.6-8.1, 2; **CCSS Math**: 3.OA.8, 3.MD.7b, 8; 4.OA.3, 4.MD.2, 3; 5.NBT.6; 6.NS.3, 6.G.1; 7.NS.3, 7.G.1; **NGSS**: 3-LS4-4, 3-5-ETS1-1, 2, 3; 3-5-ESS3-1; MS-ETS1-1, MS-ESS3-3, 4, 5; **Visual Arts Content** (Grades 3-8): 2.0 Creative Expression
Sources: farmindustrynews.com/farm-equipment/20-technologies-changing-agriculture#slide-10-field_images-45641, animalsmart.org/animals-and-the-environment/farmers-stewards-of-the-environment, www.fsa.usda.gov/programs-and-services/conservation-programs/index, www.fastline.com/v100/tractortimeline.aspx, www.americasheartland.org/episodes/episode_821/california_tractor_days.htm, Ag Alert: July 13, 2016, www.californiabountiful.com

Stay Calm and "Native" On!



New plant and animal species have been introduced into California since the mid-1700s. Not all of these species are desirable. Agriculture can be affected by the undesirable species. These undesirable, or invasive species, can spread rapidly, reproduce quickly, and cause problems with farmers' crops and livestock, not to mention the environment. So, stay calm and read on to learn more:

- **Native:** A plant or animal that is part of the balance of nature that has lived in or developed over hundreds of years in a particular region or ecosystem.
- **Non-Native:** A plant or animal introduced with human help (intentionally or accidentally) to a new place or new habitat where it was not previously found.
- **Invasive:** A plant or animal that is non-native and able to establish in many areas, grow or reproduce quickly, and spread to the point of disrupting plant communities and ecosystems. Important! Not all non-native species are invasive.

Activity *Define Native, Non-Native, and Invasive in your own words - share with a friend!*

Transportation Trivia - Insects!

Due to an increase in trade and travel over the past century, insect populations have increased rapidly which directly affects agriculture. Invasive insects are transported many ways including "hitchhiking" in produce, firewood, luggage, etc. This has had a significant effect on agriculture. Review the invasive insects and complete the chart. Go to **learnaboutag.org/resources/fact_invasion.cfm** for more information.

Insect	Origin	Effect on Ag	Miles
Oriental Fruit Fly	Taiwan	Attacks 200 different crops.	6,700
European Grapevine Moth	Italy		
Asian Citrus Psyllid		Destroys citrus crops.	7,700
Mediterranean Fruit Fly		Lives in various climates and attacks more than 250 crops.	

ANSWERS: European grapevine moth: Reproduces rapidly and has no natural predators, 6,200 miles; ACP: Southern Asia; Medfly: Africa, 6,000 - 10,000 miles.

Native or Non-Native Activity

Research online to learn more about each species. Using information from this page, complete the columns for Native or Non-Native and Invasive or Not Invasive.

Species	Native or Non-Native	Fact and Ag Connection	Invasive or Not Invasive
CA Poppy	Native	1. Named the state flower of California in 1903. 2. Can be part of habitat restoration.	Not Invasive
Yellow Starthistle	Non-Native	1. Poisonous to horses. 2. Spreads easily on rangeland reducing forage and habitat.	INVASIVE
Black Bear	Native	1. They are opportunistic eaters: they eat grasses, roots, berries, and insects. 2. Will raid beehives.	_____
Mallard Duck	Native	1. Migratory birds, they travel the Pacific Flyway. 2. Rice fields provide feed and resting areas for them.	_____
Monarch Butterfly	_____	1. Migrate south every fall, about 2,000 miles, to a warmer climate. 2. Living mostly near meadows and grasslands, monarchs pollinate many types of wildflowers.	Not Invasive
Lupin	_____	1. Grows as a wildflower in California. 2. Can be toxic for cattle grazing on rangeland.	_____
Valley Oak	_____	1. Provide nesting habitat for red-tailed hawks. 2. Once covered the valley, old farming practices cut many down.	Not Invasive
California Tree Frog	_____	1. Lives in Coastal Southern California. 2. Eats insects, spiders, centipedes, and other invertebrates.	Not Invasive

ANSWERS: Black Bear: Not Invasive; Mallard Duck: Not Invasive; Monarch Butterfly: Native; Lupin: Native, Not Invasive; Valley Oak: Native; California Tree Frog: Native

Agriculture Uses Native Plants

Native plants are used in farming in many ways. They are used as cover crops to help suppress weeds, build productive soil, and help control pests and diseases. Native plants are also grown near fields to provide nectar, pollen, and seeds that serve as food for native butterflies, insects, birds and other animals.


Cover crops can help control vineyard pests by providing habitat for predators.

Did you Know? In the 1970s, the development of Integrated Pest Management (IPM) research began. IPM naturally controls pests through crop rotation, utilizing predator species (such as ladybugs), and deploying Genetically Engineered (GE) crops which are protected from certain pests and diseases. Pesticides are used only if natural control methods are not successful. For more information, check out www2.ipm.ucanr.edu/WhatIsIPM.

Citizen Science
Go to www.iNaturalist.org and help scientists! Observe and document your native, non-native, and invasive species findings.

Service Learning
Create a Public Service Announcement (PSA): With a group, brainstorm a message to teach about Invasive species. Write a script, act it out, and record your PSA. Keep it to 30 seconds and show your class!

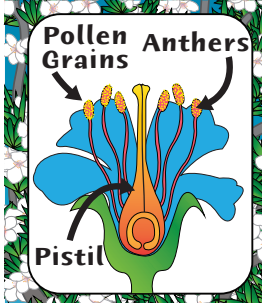
CA Standards: ELA CC: RI.3-5.1, 3, 4, 5, 7; W.3-5.2, 5, 6, 7, 8; SL.3-8.1, 4, 5; RST.6-8.1, 3, 4, 7; WHST.6-8.2, 5, 6, 7, 8; Math CC: 3.MD.3; 5.NF.6; 6.RP.3c; 7.RP.3; NGSS: 3-LS3-2, 3-LS4-3, 4; 5-ESS3-1; MS-LS1-5, MS-LS2-2, 5

Sources: nrcs.usda.gov, learnaboutag.org, Cal-ipc.org/ip/inventory, Nrm.dfg.ca.gov, Parks.ca.gov, Iscc.ca.gov

Prolific Pollinators

What is Pollination?

Pollination is the transfer of pollen grains from the male anthers of flowers to the female pistils of flowers. This allows for fertilization which allows the flowers to produce seeds.



Pollinator Math:

1. A ¼ cup of bees is about 200 bees. If a colony of bees contains 40,000 bees, how many cups of bees is that?

_____

2. An 8-frame colony of bees contains 12,000 bees. How many bees are in 1-frame?

_____

3. Almond flowers produce about 1.0 mg of pure pollen. If you have 2 million flowers/acre, about how many grams of pollen will be produced on a 100-acre orchard? If 1 gram = .0022 pounds, how many pounds of pollen is that?

_____

(Answers: 50 cups, 1,500 bees, 440 pounds)

Pollinators are essential to agriculture and the environment. 80% of plants are pollinated by animals (biotic pollination) and 20% are pollinated by wind and water (abiotic pollination). There are about 200,000 species of animals that pollinate, most of which are insects and only about 1,000 of which are vertebrates such as birds, bats, and small mammals. For abiotic pollination, 98% is due to wind and 2% is from water.

Activity Use this information to create a pollinator graph.

Activity

Using the information from the pollinator chart below, or your own research, write the pollinator's name on the top line. Then list three facts about them.

Pollinator:	Pollinator:	Pollinator:	Pollinator:	Pollinator:	Pollinator:
_____	_____	_____	_____	_____	_____
1._____	1._____	1._____	1._____	1._____	1._____
2._____	2._____	2._____	2._____	2._____	2._____
3._____	3._____	3._____	3._____	3._____	3._____

Pollinator Chart

POLLINATOR	PLANTS THEY VISIT	FACT
Honey Bees	Almonds, Apples	Visit flowers to get pollen or nectar for their food.
Monarch Butterfly Caterpillar	Milkweed	Sheds, or molts, its skin five times before the pupa stage.
Bats	Avocado, Peaches, Figs	Bats use smell, sight, and echolocation to find flowers.
Beetles	Magnolia trees, Spirea shrubs	Around for 200,000,000 years! Largest group of pollinators.
Hummingbirds	Blueberries, Honeysuckle, Salvia	Fly up to 60 mph, wings beat 20-170 beats per second.
Gray Hairstreak Butterfly	Mallows, Legumes, Alfalfa	Caterpillars known to cause damage to certain crops.

Pollinator Conservation:

There is a concern that we are losing pollinators due to habitat loss, disease, parasites, and environmental contaminants. Farmers help by planting cover crops, wildflowers and native grasses in areas not in production. By building hedgerows, windbreaks, and providing a variety of flowering plants, farmers are attracting the native pollinators they need to grow their crops. How can you help? Add bee-friendly plants to your school yard or home to help increase native honey bee populations.

Activity

Create a Pollinator Poster or Collage. Illustrate, color and label at least five pollinators. Be creative!

Service Learning

Provide a shelter for bats! Go to Bat Houses at www.thisoldhouse.com/how-to/fun-family-project-how-to-build-bat-house.

Citizen Science

Try this! Check out Zombee Watch at www.zombeewatch.org to learn more about the zombie fly, how it is a parasitoid to honey bees, and how you can help!

CA Standards: CCSS ELA: RI.3-8.4, SL.3-8.2, 5; CCSS Math: 3.OA.2, 3; 4.OA.3, 4.NBT.1, 5.NBT.1, 7, 6.RP.3d

Sources: plants.usda.gov/pollinators/Native_Pollinators.pdf, PollinatorLive.pwnet.org, vmga.net/PDF/Jim%20Revell%202015%20Talk.pdf, www.fs.fed.us/wildflowers/pollinators, www.beebristol.org/pollinators, www.nrcs.usda.gov

Animal Agriculture

Animals not only give us food and fiber, they also provide nutrients to grow crops.

How do cows contribute to sustainable agriculture?

1. Production

One cow produces an average of 144 servings of milk per day, which is enough for 48 people to get 3 daily servings of milk. How many gallons of milk is that? _____

(Answer: one serving = one cup, 16 cups per gallon, 144/16 = 9 gallons)

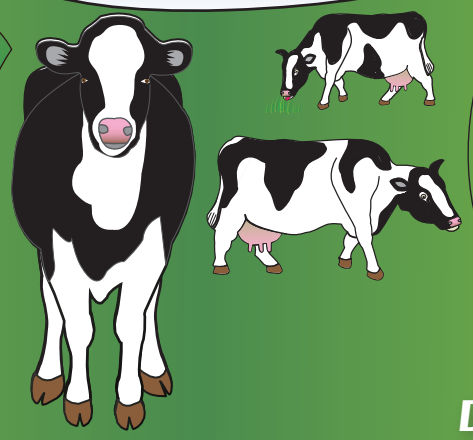
2. By-Products

Cows can eat by-products such as almond hulls and tomato **pomace** that otherwise might go straight to a landfill!

Activity

- Cows are ruminants; name three other **ruminant** animals: _____
- An animal that is a ruminant chews their __ __ __

(ANSWERS: examples include: goats, sheep, buffalo, deer, camels; cud)



3. Nutrients

One cow produces 17 gallons of manure per day which provides enough soil nutrients to fertilize 56 pounds of corn or 84 pounds of tomatoes!

JUST THINKIN' – Just like plants need nutrients to grow, so do people! Milk is rich in nutrients people need – name two: _____

_____

(Answers could include: calcium, vitamin D, potassium, or protein)

4. Innovations

Manure is becoming a source of additional value. Anaerobic digester systems convert manure into energy.

What about Waste?

Utilizing animal waste is becoming increasingly important. You've learned about Dairy Digesters on this page, now research other methods of how animal waste (biomass) can be utilized. Work with a team to create a Waste Solutions plan.

1. How is biomass currently used? What are the pros and cons?
2. Brainstorm and develop new ideas to use biomass, "Waste Solutions."
3. Present your Waste Solutions plan to the class. Have your class evaluate and vote on which options are the most reasonable. Add to the Waste Management Chart.

Waste Management Chart

Animal	Products	Uses for Waste	Waste Solutions	Class Vote
Dairy Cows	Milk, cheese, yogurt	Renewable energy, bio-fuel		Yea: ___ Nay: ___
Beef Cattle	Meat, leather, medicine	Fertilizer		Yea: ___ Nay: ___
Sheep	Meat, wool, lanolin	A natural, slow-release fertilizer		Yea: ___ Nay: ___
Poultry	Meat, eggs	Fertilizer		Yea: ___ Nay: ___

Dairy Digesters

A Dairy Digester uses dairy manure to produce biogas. Composed mostly of methane, biogas can be used to generate electricity or as transportation fuel. Check out www.cdfa.ca.gov/oefi/ddrdp and view the "Cow Power" video to learn about the SMUD project at New Hope Dairy.

Photo courtesy SMUD

Activity

Research and learn more about anaerobic digesters. How many are being used in CA? Are they making a difference? Write a report and give a presentation to your class explaining the process. Discuss the pros and cons of digesters and include a visual display. Check out this Dairy Digester at www.youtube.com/watch?v=wc-YyfftMjQ.

Homophone Chart

Homophone	Meaning	Illustration	Homophone	Meaning	Illustration
Waste	Manure, garbage, unused		Waist	Area around middle of your body	
Ate			Eight		

N.I.E.

Did you know "waste" is a homophone? Two examples are waste - waist and ate-eight. Look for more homophones in your local newspaper, add them in and finish filling out the chart. Create a homophone notebook to share with your class!

Photo courtesy Steve Beckley

California farmers provide habitat for wildlife animals too. Each year approximately seven million ducks and geese migrate along the Pacific Flyway and use rice fields to feed and rest. Check out calrice.org for more information and examples of migratory birds.

CA Standards: ELA CCSS: RI.3-5.1, 3, 7, W.3-8.7, 8, SL.3-8.1, 4, L.3-8.5, RL.6-8.3, RST.6-8.1, 7, WHST.6-8.6, 7, 8; NGSS: 4-ESS3-1, 5-ESS3-1, MS-ESS3-3, 5

Sources: www.usdairy.com/sustainability, www.healthyeating.org, www.energy.ca.gov/biomass/anaerobic.html, www.eschooltoday.com/energy/renewable-energy/biomass-energy.html

Plants through Time

Take a journey through time and learn how far we've come with plant breeding!

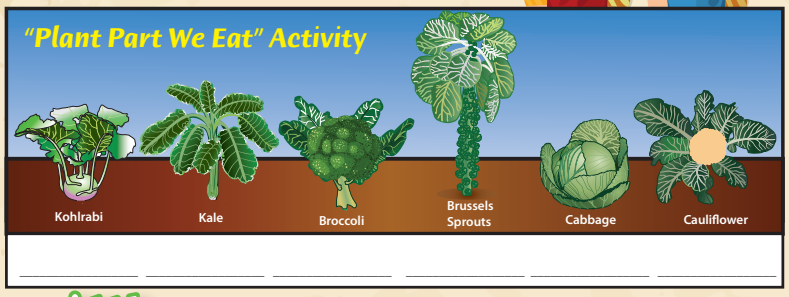
7800 BC

Farming Begins!

About 10,000 years ago humans first started growing food and moved away from hunting and gathering. These first farmers selected food plants with a particular desired **trait** and used those plants as their seed source for their next crop.

753 BC to 476 AD

The cultivation of kale began about 2000 years ago with the Ancient Greeks and Romans.



Activity

Kale is a descendant of *Brassica oleracea*, a wild mustard plant. The ancient Greeks and Romans noticed that some plants had longer and curlier leaves. The plants were bred together and produced the subspecies of kale. Some of the wild plants had larger flower buds and were bred together to produce broccoli and cauliflower. Fill in the plant part we eat (stem, leaves, buds, flowers) under the name of the plant above. Also, check out this online video: www.untamedscience.com/biodiversity/wild-cabbage

ANSWERS: kohlrabi-stem, kale-leaves, broccoli-flower & stem, Brussel sprouts-buds, cabbage-leaves, cauliflower-flower

1866

Gregor Mendel discovered genetics. He conducted experiments with garden peas and discovered that specific traits are transferred from parent to offspring. Through Mendel's experimentation with pea plants, he was able to select for plant height, pod shape and pod color.

Activity

***Punnet Square Activity*: Determine the probability of pea pod color based on the genes passed on by the parent plants.**

1. One parent plant is homozygous recessive gg (yellow pods) and the other parent plant is homozygous dominant GG (green pods). Looking at chart #1 below, what is the probability the offspring will have green pods? _____ . What is the probability for yellow pods? _____ .

2. If one parent is heterozygous Gg (green pods) and the other parent plant is homozygous gg (yellow pods), what will be the outcome? Complete chart #2 and determine the probability the offspring will have green pods _____ and yellow pods _____ .

1.

	g	g
G	Gg	Gg
G	Gg	Gg

2.

_____	_____	
_____		
_____		

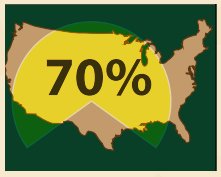
ANSWERS:
1. Heterozygous Gg will be green pods so 100% of the offspring will have green pods (Gg), 0% will have yellow pods (gg);
2. 50% will have green pods (Gg) and 50% will have yellow pods (gg)

2050

What's next?

Our world population is growing. How will farmers produce enough food with limited resources? What new plant technologies will help us in the future? Talk with a partner and come up with ideas!

2016



Over 70% of the foods we eat contain ingredients that have been genetically modified. There are 9 commercially available GMO crops: corn, soybeans, cotton, alfalfa, sugar beets, canola, papaya, squash, and potatoes. Farmers use GMOs so they can grow crops that are disease and insect resistant, as well as drought and herbicide tolerant.

Citizen Science

Join a national network of citizen scientists and monitor plants as the seasons change. Go to Project Bud Burst at www.budburst.org

Service Learning

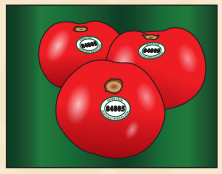
Help biodiversity; become a seed saver! Go to www.exploratorium.edu/gardening/control/seeds/index.html to learn more.

What are GMOs?

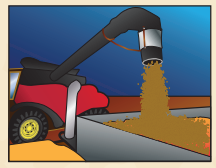
A gene with a desired trait such as "pest resistance" is identified within a plant. This trait is transferred to a new plant. The new plant is tested for food and environmental safety. Once approved, it is used to grow stronger plants that have less problems with pests. Farmers are then able to use less chemicals such as pesticides to protect the crop from damage. Check out **gmoanswers.com** to learn more about GMOS.

1994

The first Genetically Modified Organism (GMO) food arrived in Grocery Stores. The FDA approved "FLAVR SAVR" tomato was a delayed-ripening tomato that had a longer shelf life than regular tomatoes.



1940-1960



The Green Revolution was a period of agricultural change that caused a dramatic increase in global agricultural production. An important development was high-yield crops such as maize, wheat and rice.

1885

Luther Burbank developed more than 800 varieties of plants. His creations included fruits, flowers, grains, grasses, and vegetables. He experimented with grafting, hybridization and cross-breeding.

***Did you Know?* Organic crops are grown on land that only uses natural fertilizers such as animal manure and compost to build healthy soils.**

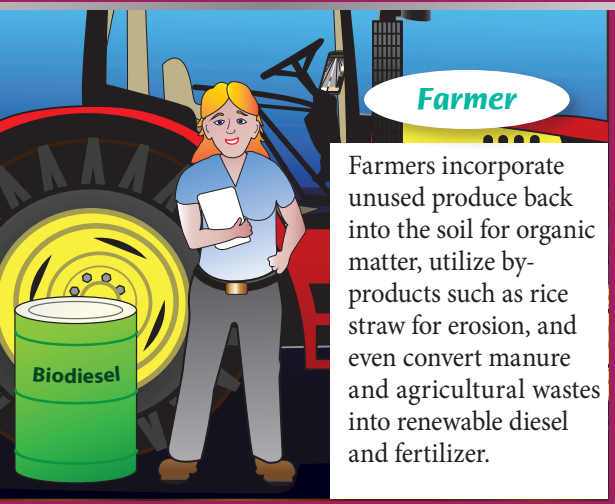
CA Standards: CCSS ELA: RI.3-6.1, 4, 7, W.3-5.7, SL.3-6.4, RI.7-8.4, W.6-8.2, 6, 7, 8, RST.6-8.4, 7; CCSS Math: 6.SP, 7.SP.5; NGSS: 3-LS3-1, 2, 5-ESS3-1, MS-LS3-2, MS-LS4-5

Sources: gmoanswers.com, b4fa.org/bioscience-in-brief/plantbreeding/what-is-plant-breeding, Smithsonian.com, en.wikipedia.org/wiki/History_of_plant_breeding

The Trouble with Trash

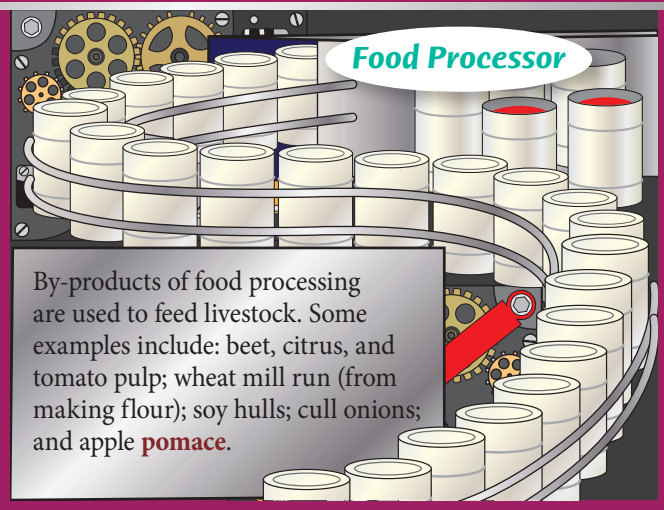
How can we ensure we do our part to reduce food waste?

90 billion pounds of edible food goes uneaten every year. Check out www.choosemyplate.gov/lets-talk-trash for awesome ideas on how to reduce food waste!



Farmer

Farmers incorporate unused produce back into the soil for organic matter, utilize by-products such as rice straw for erosion, and even convert manure and agricultural wastes into renewable diesel and fertilizer.

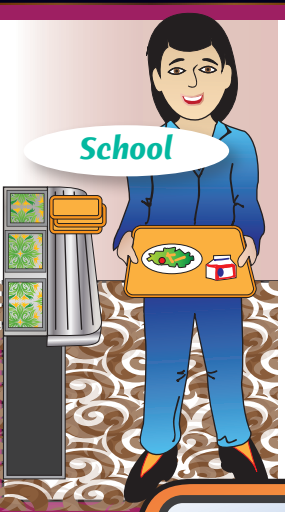


Food Processor

By-products of food processing are used to feed livestock. Some examples include: beet, citrus, and tomato pulp; wheat mill run (from making flour); soy hulls; cull onions; and apple **pomace**.

Grocery Store

Purchasing food from their deli or salad bar allows grocery stores to use imperfect produce. Shop often for small amounts of fresh produce to reduce spoilage and waste. Buy fresh food at Farmer's Markets or shop locally for what's in season.



School

Encourage food sharing tables and allow students to serve themselves.

Challenge: Think about the extra food from school at breakfast, snack and lunch times. Brainstorm 3 ways to reduce waste at your school:

1. _____
2. _____
3. _____

Check out Food Product Dating at www.fsis.usda.gov

Home

Use overripe and bruised food in smoothies and other recipes. Freeze or preserve excess produce (bananas, tomatoes, etc.) for future use.

Plan ahead Challenge!

Name 3 meals you cook at your home and make a shopping list! Don't buy more than you need!

Meals	List
1 _____	_____
2 _____	_____
3 _____	_____

When eating at restaurants, order smaller portions, or hold extras such as chips and bread if you don't plan to eat them.

Challenge: What do you order at a restaurant, and do you consume everything you order? What can you do to reduce your food waste?

_____

_____

_____

Restaurant

POSSIBLE ANSWERS: Request "to go" box for extra food, take leftover bread/chips home, split entrée with a friend.

Challenge: 1. Using the Labels Chart below, which type of label do you think causes the most food waste? _____

Why? _____

2. How will you store your food to keep it fresh? _____

_____

Labels Chart

LABEL	Sell by	Best if used by (or before)	Use by
WHAT IT MEANS	Informs retailers how long to display a product for sale.	Recommended for best flavor or quality. It is not a purchase or safety date.	The last date recommended for the use of the product while at peak quality.

ANSWERS: 1. Sell by date is wasteful because people assume it must be eaten by then and toss it too early. 2. Watch storage dates, temps, storage containers, and amount in container.

Citizen Science

FOOD WASTE AUDIT: Follow the lead of San Mateo County and conduct a food waste audit at your school. Check it out: www.recycleworks.org/schools/s_audits

Service Learning

Check out the "Waste No Food Smart Phone" application at www.wastenofood.org It connects people with excess food to the hungry. With your classmates, create a brochure to educate others about this opportunity.

Bingo Brainstorming Activity

Ask a classmate to answer each of the following BINGO card questions. Have a conversation with them, each sharing your own ideas. Record their answer.

List one way you can reduce wasting food at home.	Name one food you might have at home and where you should store it.	Name one thing to check on the food label before making a purchase at the grocery store.
What is one way to track food in the refrigerator, to help reduce waste?	Free Zone	Explain one way to organize the way you store food at home to minimize waste.
Name one way to repurpose extra food at school or home.	Name one food that you can freeze or eat later.	Name one place in your community where you can donate extra food.

CA Standards: CCSS ELA: W.3-8.2, S.L. 3-8.1, RI.3-8.1

Sources: www.nationalgeographic.com/magazine/2016/03/editors-note-reduce-your-food-waste, www.epa.gov/sustainable-management-food/reduce-wasted-food-feeding-hungry-people

Agriculture and the Environment Glossary

Abiotic: Non-living parts of the environment such as sunlight, wind, rocks, and rain.

Anaerobic Digesters: Microorganisms break down biodegradable material in the absence of oxygen. One of the end products is biogas which can be combusted to generate electricity and heat or can be processed into renewable natural gas and transportation fuels.

Biomass: Derived from living or once living organisms. Wood and manure are considered biomass.

Biotic: Of or relating to living things, including plants, animals, and microorganisms.

Carbon Footprint: The amount of greenhouse gases produced from human activities, it includes carbon dioxide and other carbon compounds.

Colony: A family unit of bees, usually about 40,000, including one queen.

Controlled Burning: A technique used in forest management, farming, or prairie restoration to reduce hazards or clean fields.

Cover Crops: Crops planted to protect soil and nutrients.

Developed Water: Water that is controlled and managed for a variety of uses.

Economy: The wealth and resources of a country or region.

Ecosystem: A system, or group of interconnected elements, formed by the interaction of organisms with their environment.

Emitting: Producing or discharging.

Forage: Food such as grass or to search for food.

Global Warming: The increased temperature of earth as indicated through ocean, earth's surface, and satellite data.

Greenhouse Gases (GHG): A gas that contributes to the greenhouse effect (sun's warmth is trapped in the planet's atmosphere) by absorbing infrared radiation, for example carbon dioxide.

Ground-level ozone: Ozone is a gas composed of three atoms of oxygen (O_3). In the upper atmosphere it protects us from the sun's harmful UV rays, but at ground-level it causes harm to animals and plants. It is the main ingredient of smog. Visit www.epa.gov/ozone-pollution/ozone-basics for more information or watch a video at www.youtube.com/watch?v=THYoUULn_2U.

Habitat: The natural environment of an organism.

Habitat Restoration: Repairs a habitat or ecosystem that has been damaged enabling native plants and wildlife to live there.

Hedgerows: A hedge of shrubs and/or trees bordering a field or road.

Homophone: Words having the same pronunciation but different meanings or spellings.

Hydroponic: Grown in nutrient solutions without soil.

Implements: Equipment or tools.

Information Technology: The use of computers and telecommunications for storing, retrieving, and sending information.

Insulating: Materials that prevent loss or absorption of heat.

Kinetic: Energy of motion, an example of kinetic energy is wind moving a windmill.

Legumes: Plants that bear their fruit inside a pod – beans and peas are an example.

Methane Digesters: Convert manure into methane and use the biogas to produce energy.

Non-renewable: A natural resource on earth that exists in limited supply, it cannot be replaced if used up.

Opportunistic: Taking advantage of what's available. Some animals are opportunistic feeders such as crows or raccoons.

Parasitoid: An insect whose larvae live as parasites that eventually kill their host.

Photosynthesis: The process plants go through to convert carbon dioxide and water into oxygen and glucose. It requires the energy of the sun.

Photovoltaic (PV): Converts light directly into electricity. A typical PV system uses solar panels, each with a specific number of solar cells, which generate electrical power. A solar cell is also called a solar battery.

Pomace: The solid remains after pressing for oil or juice.

Ruminant: Mammals that have a stomach divided into four compartments and chew their cud.

Species: A group of plants or animals that are similar and can produce young.

Tillage: Preparation of soil by digging or overturning. Uses mechanical processing with implements such as discs, plows or rippers. Tillage by hand would use shovels, hoes, or rakes.

Trait: Characteristic.

Urban: Related to or in a city or town.

Windrows: A line of raked hay laid out to dry in the sun.

Activity

Choose two glossary words and use both in a complete sentence. Write your sentence in the space provided.

_____

_____

_____

_____

Resources:

California Ag Water Stewardship Initiative
www.agwaterstewards.org

California Air Resources Board
www.arb.ca.gov

California Department of Food and Agriculture
cdfa.ca.gov

California Energy Commission
www.energy.ca.gov

California Environmental Education Interagency Network
www.coastal.ca.gov/publiced/ceein

California Farm Bureau Federation
www.cfbf.com

California Foundation for Agriculture in the Classroom
LearnAboutAg.org

California Naturalist Program
calnat.ucanr.edu

CalRecycle
www.calrecycle.ca.gov

Dairy Council of California
www.healthyeating.org

Natural Resources Conservation Service
www.nrcs.usda.gov

To request a free copy of ***What's Growin' On? Extra! Extra! Extensions*** to enhance the use of this newspaper, visitLearnAboutAg.org/wgo or call (800) 700-AITC (2482).

CA Standards: ELA CCSS: L.3.2g, 4d, 5b, 6; L.4.2d, 4c, 6; L.5.2e, 4c, 6; L.6-8.4c, 4d, 6

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cdfa — California Department of Food & Agriculture

WPHA — Western Plant Health Association

Monsanto imagine

California Beef Council

Bayer CropScience

pork — California Pork Producers Association

Bob Johnson

syngenta

Real California Milk / Real California Cheese — Look for the Seals

CTA — California Teachers Association

California Walnuts — www.walnuts.org

CALAMCO — A Partnership with Growers

SMUD

Grimmway Farms — A family of Growing companies.

Kitayama Brothers

Dairy Council of California — Healthy Eating Made Easier

The Brandt Foundation

Willowood USA

California Poultry — California Poultry Federation

Olive Hill Greenhouses, Inc.

Lakeside Organic Gardens

California Cotton Alliance

Crop Production Services

california almonds — Almond Board of California

Grand National Foundation

The Lyman Group Inc.

TGI The Tremont Group, Inc.

Sierra Pacific Foundation — Growing Healthy Communities

Pacific Gas and Electric Company

Port of Oakland

Union Pacific — Building America

Agrium

The Bertha and John Garabedian Charitable Foundation

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