What's Growin' On?

21st Edition

Weather Wise

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Becoming Weather Wise...

If you've ever experienced a sudden downpour, you know we have little control over the weather. Our lives are at the mercy of the atmosphere! However, over the past few decades, we have become increasingly better at predicting weather events. Accurate forecasting—using science to predict or estimate a future weather event—has positively impacted farmers and ranchers, making them more weather wise than ever. Weather wise means responding to the changes in our atmosphere with smart farming decisions that benefit crops, livestock, and our environment.

While reading this newspaper, you might be surprised to discover the delicate balance between productivity and destruction. You will learn that rainfall can encourage growth or devastate crops. Cool temperatures can hinder seed growth, and hot temperatures can scorch plants. Not to mention the many forms of extreme weather that can harm livestock and crops alike. However, despite these risks and uncertainties, California farmers and ranchers still produce more than 400 different commodities—agriculture products that enrich each of our lives every day.

From the Farmer's (and Rancher's) Mouth!

Curious about what California farmers and ranchers have to say about becoming weather wise? Watch this short video to get the inside scoop on growing in the Golden State, come rain or shine!

Read All About It!

For the past 21 years, California Foundation for Agriculture in the Classroom has produced *What's Growin' On?* to help students explore the many ways agriculture impacts their daily lives. This year's edition, *Weather Wise*, is inspired by the weather events and related systems that influence agriculture in the Golden State. In many ways, it's also a celebration of the farmers and ranchers who continue to produce our food, fiber, flowers, fuel, and forests—despite weather challenges and complexities—allowing our communities to thrive.

Each annual edition of *What's Growin' On?* is developed by educators and reviewed by agriculture industry experts to ensure the content is both relevant and accurate. The activities inside are aligned to California Academic Standards, including Common Core and Next Generation Science Standards, for grades three through eight. We hope you enjoy becoming weather wise!

A Hot (& Cold!) Topic

The rising or falling temperatures related to a changing climate can have devastating effects on our environment, including food production. Agriculture and fisheries depend on specific climate conditions to be productive, and when those climate conditions change, it can disrupt food availability and affect food quality.

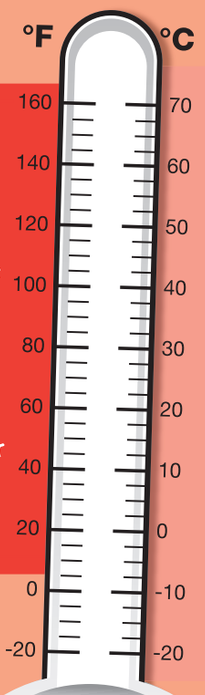
Did you know?

Warmer temps may cause lettuce or other leafy greens to bolt. Bolting means that the plant sends up a flower stalk and goes to seed, giving the greens a bitter taste.

Activity

Celsius and Fahrenheit are different scales used to measure temperature. On the thermometer diagram, use a colored pencil to mark the temperature for:

- √ chill units
- √ a hot day
- √ a cold day
- √ freezing water
- √ body temperature



Convert 86°F to degrees Celsius
°C = 5/9 (°F-32)

Convert 13°C to degrees Fahrenheit
°F = (°C x 9/5)+32

Standards: CC Math: 5.0A.1, 5.NF.4A, 4.MD.2; NGSS: 3-ESS2-1

Just Chill

Some tree crops, such as apples, pears, and stone fruits, require a set amount of "chill units" in order to bear fruit. Once a tree has experienced enough hours in temperatures between 32 and 45°F "chilling," flowers and leaf buds will develop normally. If the buds do not receive enough chill units, trees may develop physical symptoms such as delayed bloom, delayed leaf production, reduced fruit set, and reduced fruit quality.

WOW! weather

The highest California temperature on record is from Furnace Creek Ranch in Death Valley, CA. In 1913, temperatures soared to 134.1°F. To put that in perspective, a medium-rare steak is cooked to an internal temperature of 130°F-135°F. Now that's cookin'!

What falls but never hits the ground?

The temperature!

EXTREME Weather Protection

When temperatures threaten to cause damage on a farm or ranch, farmers can use different strategies to protect their crops and livestock.

TOO HOT

Misters and fans help dairy cattle stay cool and not experience heat stress, which can harm the animal and reduce milk production.

Heat sensitive crops, like sweet corn and tomatoes, are sometimes harvested at night to beat the heat. Night harvest protects workers from heat illness and keeps produce fresh.

TOO COLD

Sprinklers used during a cold frost can prevent grapevine damage. As the water turns to ice, it insulates the plant and releases small amounts of heat.

Shelters, such as barns or sheds, protect livestock from extremely cold weather. Extra feed rations will give animals the energy they need to stay warm.

CROP FORECAST

ALMONDS 50°- 86°	APPLES 32°- 45°	RICE 60°- 90°	BELL PEPPERS 70°- 80°	ORANGES 70°- 90°
Temperatures below 28°F during or after flowering will damage flowers and prevent nuts from developing.	Most apple varieties need between 500-1,000 chill hours to properly set fruit the following spring.	Rice can be grown in areas where temperatures stay above 60°F and there is plenty of water.	Peppers, like tomatoes, are sensitive to temperature. Most peppers will drop their blooms when temperatures rise above 90°F.	Citrus trees need warm winters and hot summers. Citrus plants should be protected when temperatures are expected to dip below 26°F.

The successful production of any crop relies on specific climate and weather conditions. Use online research tools to determine the optimal growing temperature for at least three other California grown commodities. Record findings in a table and include illustrations of each commodity. **Standards:** NGSS: 3-ESS2-1; CC ELA: W.3-5.7

Sources: United States Geological Survey (usgs.gov) | University of California Agriculture and Natural Resources (ucanr.edu) | United States Department of Agriculture (usda.gov) | The Intergovernmental Panel on Climate Change (ipcc.ch)

Round & Round It Goes

Water is the planet's most precious resource—we use it to brush our teeth, wash our clothes, generate electricity, and grow our food. Water is as old as earth itself, which means it's possible that you could be drinking the same water as a stegosaurus or a tyrannosaurus because of the way water circulates around our planet. The water cycle is the continuous flow between earth and the atmosphere.

Activity

Use the definitions below to label the different phases of the water cycle in the diagram.

Evaporation:
Energy from the sun warms the water in lakes, rivers, and the ocean. The heat changes the water into a gas, called water vapor. The water vapor goes into the air.

Condensation:
Water vapor in the air gets cold. It changes from a gas to a liquid. Tiny water droplets collect in the form of clouds.

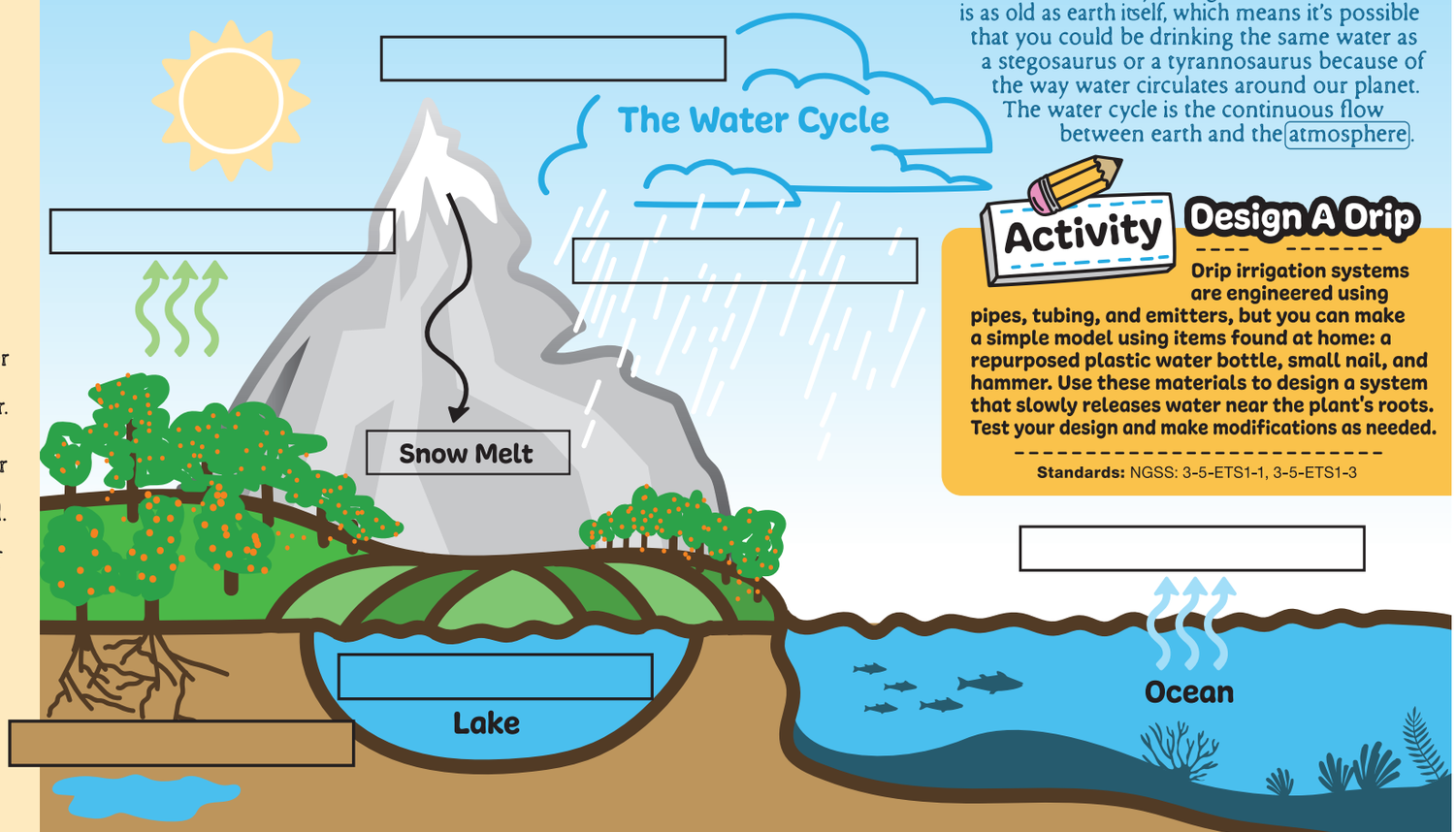
Precipitation:
When the clouds cannot hold all the water, it falls back down to the Earth. The water comes down as rain, hail, sleet, or snow.

Accumulation:
Water that falls back to Earth collects in oceans, lakes, or rivers. It eventually evaporates, beginning the cycle again.

Percolation:
Water that falls on land moves through soil until it reaches the water table. It moves underground where it is stored as groundwater until it evaporates again.

Transpiration:
The process of water movement through a plant and its evaporation from the plant through leaves, stems, and flowers.

Standards:
NGSS: MS-ESS2-4
CC ELA: RST.6-8.7



Activity

Design A Drip

Drip irrigation systems are engineered using pipes, tubing, and emitters, but you can make a simple model using items found at home: a repurposed plastic water bottle, small nail, and hammer. Use these materials to design a system that slowly releases water near the plant's roots. Test your design and make modifications as needed.

Standards: NGSS: 3-5-ETS1-1, 3-5-ETS1-3

Don't Hesitate, Irrigate!

Throughout the world, irrigation—water for agriculture use—is probably the most important use of water besides drinking it! Irrigation water is essential for keeping fruits, vegetables, and grains growing to feed the world's population. Many farmers understand that the Earth's freshwater is limited and use modern irrigation systems to conserve water.

Drip irrigation involves placing tubing with emitters on the ground alongside the plants. The emitters slowly drip water into the soil near the roots.

Commonly used in orchards, **micro-sprinklers** spray the ground near the tree's trunk. Water is applied only when needed and where the tree needs it most.

Sub-surface irrigation is when irrigation water is applied below the ground surface by using a buried pipe system that applies water near the plant's roots.

WOW! weather

Although water covers 71% of the Earth's surface, freshwater is limited—97% is salt water. Almost all freshwater is locked up in ice and in the ground. Only a little more than 1.2% of all freshwater is surface water, which serves most of life's needs.

Did you know?

The amount of water on the planet never changes, but its form does. It can be solid (like snow and ice atop a mountain), liquid (stream, rivers, and oceans), and gas (water vapor warmed by the sun).

Sources: National Weather Service (weather.gov) | United States Geological Survey (usgs.gov) | Water Education Foundation (watereducation.org)

RAIN... Right on Time

Rain has an essential role in agriculture and the environment. It replenishes creeks, reservoirs, and the water table. Rain is used to water food and fiber crops, and pastures for animals. It provides a habitat for numerous species of fish and wildlife. While a regular rain pattern is vital to healthy plants, too much or too little rainfall—or rainfall at the wrong time of year—can be harmful, even devastating to crops.

Why do cows lie down in the rain?

To keep each udder dry!

Did you know?

Raindrops are not really shaped like a drop, they are actually shaped like a ball (round) or button (flat).

When is Right on Time?

Well, it depends...Most farmers don't want rain before a scheduled planting or harvest since wet conditions make moving tractors and heavy machinery difficult. Light rain during the growing season can help certain crops and pastures grow. Moderate rain during the winter season can replenish groundwater that can be used during dry seasons.

2017 was a record-setting year for California, with an average of 41.66 inches of rainfall statewide (normal year average is 22.9 inches). The heavy rain caused Lake Oroville, located in Northern California, to fill toward its brim. Dam operators released heavy flows down the Feather River, but a crisis began when a crater opened on the main spillway, damaging the river banks and destroying large areas of farmland.

WOW! weather

La Niña vs. El Niño

La Niña ("little girl" in Spanish)	El Niño ("little boy" in Spanish)
is a climate pattern that describes the cooling of surface ocean waters along the tropical west coast of South America which typically leads to less rain.	is a climate pattern that describes the unusual warming of surface waters along the west coast of Mexico and Central America which typically leads to more rain.

La Niña and El Niño together are part of a cycle that influences extreme weather and can impact food production, not just in the U.S. but all over the world. This 2-minute video by The National Ocean Service shows how these events affect weather.

After watching, make a list comparing and contrasting the different ways El Niño and La Niña affect weather in the U.S.

Standards:
CC ELA: Writing 6.2.A, 6.2.D; NGSS: MS-ESS3-1

Activity

Rain...Good News or Bad News?

Rain is central to food and fiber production. But on the other hand, rain at the wrong time can be devastating to farmers. This table includes information about when rain is good news and when rain is bad news. Think about your family and how you respond to wet weather. When is rain good news? When is it bad news? Add your examples to the table.

Good News

1. When lakes and reservoirs are low and need to be refilled.
2. Light, steady rain soon after seedlings have been planted.
3. Rainfall after a dry, dusty period to wash away dust from plant leaves.
4. Rain replenishes aquifers, supplying water to agricultural wells.

_____

_____

Bad News

1. Rainfall during warm weather increases humidity and may cause disease or pest problems.
2. Tractors cannot enter muddy fields to harvest or plant.
3. Rain can wash away fertilizer making it less effective.
4. Heavy rain can flood fields, making it hard for plant roots to get enough oxygen.
5. _____

_____

Standards: CC ELA: RI.3.3, RI.5.3, RST.6-8.2

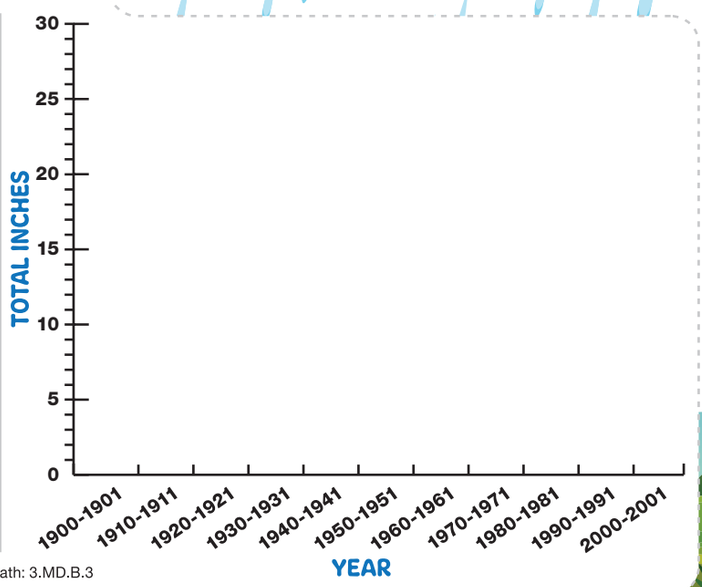
Sources:
University of Minnesota (umn.edu)
OEHHA (oehha.ca.gov)

Activity

Measuring Rainfall

Meteorologists measure rainfall in inches. They use an instrument called a rain gauge to collect and measure rain. Use the table to create a bar graph showing the annual total precipitation in Sacramento, California.

YEAR	TOTAL INCHES
1900-1901	20.21
1910-1911	21.98
1920-1921	16.80
1930-1931	8.43
1940-1941	31.83
1950-1951	19.54
1960-1961	12.04
1970-1971	17.42
1980-1981	13.43
1990-1991	14.73
2000-2001	17.31



Standards: NGSS: 3-ESS2-1; CC Math: 3.MD.B.3

Follow the Snowflake

California farms depend on the snow falling, sometimes hundreds of miles away, to grow the food we buy at the grocery store.

Snow falls on the mountain tops, creating snowpack. When the days get warmer, the snowpack begins to melt.

WOW! weather

Snow is rare at sea level, but snow has been recorded twice in San Francisco: December 11, 1932 and January 15, 1952. Snow that falls in unexpected places can cause significant damage to agricultural or ornamental plants, many of which can only survive in temperate climates.

Melted snow changes into water that seeps into the ground or runs off into lakes, streams, rivers, and other bodies of water.

Where do Snowmen put their money?

Snowbanks!

As water flows downstream it is used for recreation, wildlife, and drinking water. Some of it may be diverted for food and agricultural production.

Each farm has water rights. Water rights are a specified amount of water that the owner is to receive each year.

Sources: Smithsonian Institute (siarchives.si.edu/history)
American Meteorologist Society (ametsoc.org) | Michigan State University Extension (canr.msu.edu)
NASA Space Math (spacemath.gsfc.nasa.gov) | Department of Water Resources (water.ca.gov)

From Summit to Stone Fruit

California and snow go hand-in-hand. Surprised? You just have to know where to look. The town of Truckee in the Sierra Nevada mountain range often ranks as the snowiest city in the United States, with an average snowfall of 203 inches a year! Snowpack, the accumulation of seasonal snow that is slow-melting, provides one-third of the water used by California's cities and farms each year.

Meet "Snowflake" Bentley

Wilson Bentley (1865-1931) was a Vermont farmer and photographer who spent over 40 years photographing the amazing world of snowflakes. Bentley's passion began when his parents purchased a camera for him as a teenager—with the cost of the camera equivalent to ten of the family's cows. He was a pioneer in the field of photomicrography, taking detailed photos of very small objects. From 1885 until his death, Bentley photographed more than 5,000 individual snow crystals.

Meteorologist Math

A meteorologist is a person who uses scientific principles to explain, understand, observe, or forecast what's happening in the earth's atmosphere. Meteorologists use math, often with the help of supercomputers, to predict and understand weather patterns. Try using the "supercomputer" inside your head to solve the weather problems below.

1. Snow can fall at different speeds. Some snow falls at a leisurely 1 mph, while other snow falls at a brisk pace of 9 mph. If a snowflake is falling at 8 mph:
   How far would it travel in 30 minutes? _____
   How far would it travel in one minute? _____

2. The annual snowfall in Truckee is 203 inches, Tahoe City is 190 inches, and Yosemite Park is 56 inches. What is the average (or median) snowfall for the three areas? What is the total snowfall for the three areas?
   Median: _____ Total: _____

3. It takes approximately 10 inches of snow to provide 1 inch of water. How many inches of snow would be needed to make:
   A. 5 inches of water? _____
   B. A foot of water? _____

Standards: CC Math: 3.OA.1, 4.OA.1, 4.OA.2, 5.NF.B.7, 6.RP.1, 6.RP.A.3

Make a Snowflake

Using a variety of materials, such as cotton swabs, craft sticks, and chenille stems, design and create a snowflake.

Use a snowflake crystal shape chart **(snowcrystals.com)** as a reference to build a model that is similar to real snow.

Standard: CA Visual Arts: 3.VA:Cr2.1

THE - Storage Story

Farmers use water storage to grow 400 different commodities like fruits, nuts, vegetables, dairy, and meat. There are two main categories of storage: storage that happens naturally, like snowpack in the mountains or aquifers underground; or man-made solutions like lakes and reservoirs.

Did you know? **In the water world, water is commonly measured in acre-feet. But what is an acre-foot? One acre-foot equals about 326,000 gallons, or enough water to cover an acre of land, about the size of a football field, one foot deep.**

Activity: How Much WATER?

This table shows the total storage of California's largest reservoirs. It also shows the percent capacity (how full) the reservoir was on June 10, 2021. Complete the table by calculating the total acre-feet of water in each reservoir when the data was collected. Round to the nearest whole number.

RESERVOIR	Total Storage (Acre-Feet)	% Capacity	Total Water Present (Acre-Feet)
Shasta Lake	1,907,481	42	
New Melones	1,329,607	55	
Don Pedro	1,316,816	65	
Lake Oroville	1,291,556	37	
Trinity Lake	1,231,052	50	

Standards: CC Math: 5.NBT.B.5, 5.NBT.B.7, 5.MD.C.5, 6.RP.A.3.C, 7.RP.A.2, 7.RP.A.3

Groundwater

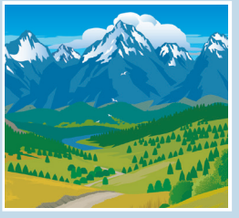
California has a large amount of underground water storage known as aquifers. Fresh water is pumped out of the ground through wells and delivered to nearby homes, farms, businesses, and communities. However, even groundwater is limited. When water is taken out of the ground faster than it can be put back in, the water table drops, leaving wells dry.

Lakes & Reservoirs

In nature, gravity draws water from the mountains to the ocean. But in California, water is stored in more than 1,000 lakes and reservoirs. To form a reservoir, engineers build a dam across a stream or a river. The dam controls the amount of water that flows out of the reservoir. Most of our lakes and reservoirs are man-made, but that doesn't change their significance for all Californians.

Snowpack

Nearly one-third of our water supply is found in California's snowy mountains. Mountain snowpacks act as natural reservoirs that hold winter precipitation (as snow) for release as snowmelt later in the year when water demands are high. Changing climate is affecting the accumulation of snow in high elevations, affecting the storage of potential water.



What is the purpose of a reservoir?

A. Recreation
B. Food production
C. Flood protection
D. Habitat for fish and wildlife
E. All of the above

If you guessed all of the above, you got it! Reservoirs have a variety of uses that contribute to our health, safety, and economy.

Activity: Make An Aquifer

In this video demonstration, you can learn how to build a model of an aquifer at home. (Spoiler alert: it even has a well that pumps out water!) Watch the video, then draw or construct the model on your own. **Standards** NGSS: 5-ESS2-2, MS-ESS2-4

Activity: Not enough water

California has competing needs for a limited amount of water. The three greatest needs—agriculture, urban use, and the environment—have been pitted against each other for more than a century in a 3-way tug-of-war for our water supply. In drought years, there is not enough water to make anyone happy.

Think of your favorite food. How would the availability of that food change if there wasn't enough water to produce it? Research the ingredients in your favorite food and write a friendly letter to the producer or manufacturer expressing your concerns.

Example: My favorite food is salsa. I'm writing a letter to the salsa company to share my concerns about the lack of water for tomato production.

Standards: CC ELA: W3-8.1, RI.3-6.1, RI.3-5.2, RA.3-6.3

WOW! weather

The Christmas flood of 1964 caused record-breaking peak streamflows, transported large amounts of sediment, and inflicted extensive flood damage. However, in many areas storage in reservoirs and operation of flood-control facilities prevented far greater damage.

Sources: California Department of Water Resources (water.ca.gov/water-basics)
SMUD Museum of Science and Curiosity (visitmosac.org)
Water Education Foundation (watereducation.org)

Water on the Move

Before gold was discovered at Sutter's Mill in 1848, California's water supply was untamed. Streams ran their natural course, and during the wet season, large areas became wetlands filled with wildlife.

As gold became more difficult to find, some miners turned to farming. Cities developed into booming metropolitan centers like San Francisco and Los Angeles. California's water needs changed rapidly, and by 1919, the concept of a statewide water development project was being considered. In 1935, with the support of the federal government, construction began.

Today, California is home to one of the largest and most complex water storage and supply systems in the world, transporting water more than 700 miles from the northern Sierra Nevada mountains south to Los Angeles and beyond.

Snow

When snow falls in the mountains during the winter months, it often accumulates as snowpack. As the snowpack slowly melts, it runs off into rivers, creeks, and streams.

Rivers, Creeks & Streams

These natural waterways allow wild and aquatic life to flourish, while also playing an essential role in moving water toward farms and cities. This water can also be stored in reservoirs, natural lakes, and aquifers.

Reservoirs

A reservoir is an artificial lake created in a river valley by the construction of a dam. Reservoirs collect water during times of high water flow, reducing flood risk, and then release the water slowly over the following weeks and months. The largest and deepest reservoir in California is Lake Shasta, with a maximum depth of 517 feet. Lake Shasta has been storing water since 1944.

Dams

A dam is a structure built across a stream or river to hold water back. Engineers and forecasters determine how much water to release throughout the year based on variables like reservoir levels, the snowpack, and long-range weather models.

Cities

County and city water departments withdraw water from rivers, lakes, reservoirs, and wells. Water treatment plants remove sediment, bacteria, and microorganisms from the water and ensure our drinking water is safe. Underground pipes deliver treated water to homes, businesses, and schools.

Farms

Pumps and ditches move water from aqueducts to agricultural land. Farmers use wells to pump water from underground aquifers. Livestock ranchers use water to irrigate pasture and care for their animals, while farmers use water to grow their crops. Modern farmers use irrigation methods that reduce water use, like drip irrigation or micro-sprinklers.

T

The Sacramento-San Joaquin De
supplying fresh water to two-thi
acres of farmland. In the Delta, s
water from Northern Californ
wildlife species. It is al
Delta flows out t
the Califor

Construct a Timeline

Use the significant events and dates on this page to construct a timeline in the space provided.

Standards: CA HSS: 4.4.7; Analysis Skills 3-5: CST 1; Analysis Skills 6-8: CST 1

Activity

Follow the Drop

Imagine you're a drop of water that's fallen into California's statewide water system. Write a narrative about your experience. Include descriptive details and a clear sequence of events. Where does your adventure begin, where does it end, and what happens in between?

Standards CC ELA: W.3-8.3

An Ancient Idea

Although earlier civilizations in Egypt and India also built aqueducts, the Roman aqueduct system was known for its complexity and scale. Built over 500 years—from 312 B.C. to A.D. 226—the system included 11 aqueducts that transported fresh water to ancient cities. The most recognizable feature of Roman aqueducts may be the elevated bridges used to carry water across valleys and over urban areas. Some of these bridges are still moving water today—2,000 years later.

California Aqueduct

An aqueduct is a channel built to transport water long distances. The California Aqueduct, one of the largest aqueduct systems in the world, spans more than 400 miles and can carry 650 million gallons of water a day.

Activity

Word Search

Scan the QR code to download and print a word search featuring the water words on this page.

Can you find them all?

At the southern end of the Delta, eleven giant pumps lift the water 244 feet from the Delta into the California Aqueduct. Pumping stations throughout the state keep water moving as it winds through the Central Valley to Southern California.

Pumps

The Delta

lta is the hub of California's water system, irds of the state's population and millions of altwater from San Francisco Bay mixes with fresh nia's rivers, creating a habitat for many fish and so a rich agricultural area. Water that enters the o the ocean through the bay or is pumped into rnia aqueduct.

Activity

Empire Engineer

Imagine you're the chief engineer for the Roman empire. How would you construct an aqueduct to supply the city with water, using limited building materials?

Using scissors, cardboard, duct tape, and plastic garbage bags, design and build an aqueduct that can move water a distance of three feet.

Sources: The Atlantic, American Aqueduct: The Great California Water Saga by Alexis C. Madrigal | California Department of Water Resources (water.ca.gov) National Geographic (education.nationalgeographic.org) United States Geological Survey (usgs.govWater Education Foundation (watereducation.org)

Blowin' in the Wind

It's easy to forget about the air around us, but on a windy day, air really makes its presence known. Differences in air pressure within our atmosphere create wind. Air under high pressure moves toward areas of low pressure. The greater the difference in pressure, the faster the air flows. In agriculture, some wind can be helpful, but too much can be devastating to those producing our food, fiber, flowers, forests, and fuel.

WOW! weather

In February 2021, a series of storms swept through Southern California causing extensive wind damage. Wind gusts reached nearly 100 miles-per-hour in higher elevations. Lemon and avocado growers experienced the most damage, with some growers estimating that 20 percent of their crop had fallen to the ground after the storm.

Did you know?

In 2020, wind turbines supplied 11% of California's total system power—more than enough to power all homes in Sacramento, San Francisco, and Los Angeles Counties combined.

Activity

Windblown WORDS

There are many words to describe wind in the English language. Some of the letters in the wind words below have been blown all over the page. Use a dictionary or thesaurus to match the missing letters to the windblown words.

B_EE_E	
C_CLO_E	DRA_G_T
GU_T	T_PHO_N
_ALE	_AFT
CH_NOO_	WHI_LWI_D
D_A_T	Z_PH_R

Why is there so much wind inside a sports arena?

Because of all the fans!

A wind farm is a group of wind turbines in the same area used to produce electricity. Wind turbines can be built on existing farms or ranches. Farmers and ranchers can continue to work the land because the wind turbines use only a fraction of the land. Wind power plant owners make rent payments to the farmer or rancher for the use of the land, providing landowners with additional income.

Scan the QR code to visit energy.gov and view a wind turbine animation which demonstrates how a wind turbine works.

WIND: Help vs. Hurt

In agriculture, wind can be helpful and it can be destructive. Here are some examples of how wind can help and hurt California farmers. Think about your family and how you experience windy weather. When does wind help your family? When does it hurt? Add your examples to the table.

Help	Hurt
1. Wind aids in pollination, as moving air transports pollen to other plants.	1. Strong winds may damage plants, and young plants can be uprooted by the wind.
2. Wind decreases the amount of moisture on leaves, which can help reduce crop diseases.	2. Wind moves dust, which can cover leaves inhibiting photosynthesis.
3. Wind helps dry fields after a heavy rain.	3. Strong winds can knock fruits and nuts from trees, damaging the commodity.
4. Wind brings in cooler temperatures which is desirable for some crops.	4. Wind can interfere with the application of crop protection materials.
5. _____	5. _____

Standards: CC ELA: RI.3.3, RI.5.3, RST.6-8.2

Wind Defense

Create Wind Breaks

Windbreaks are linear plantings of trees and shrubs designed to protect an area from strong winds. A windbreak planted perpendicular to the prevailing wind can reduce wind speed by 10 percent.

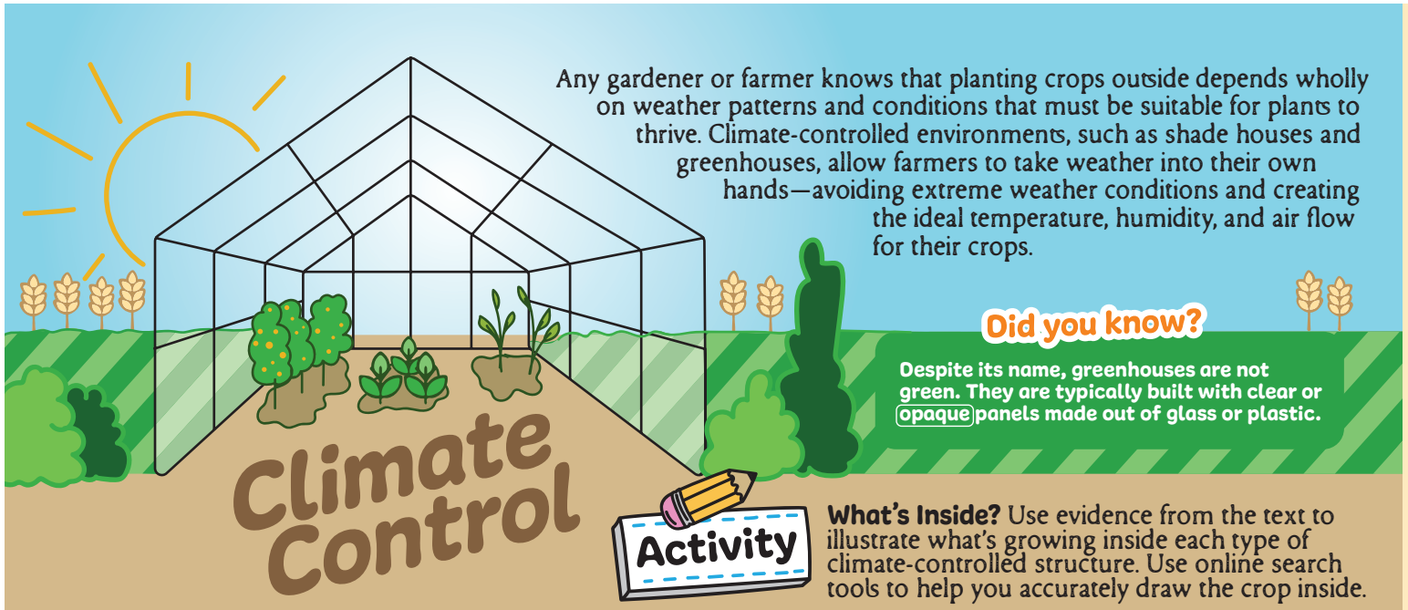
Stake Young Plants

Growers tie the trunks of young trees to wooden or metal stakes driven into the ground. The stakes are typically on the same side as the prevailing wind.

Control Dust

In rural areas, the combination of dust and wind can damage crops and pose a risk to human health. To reduce dust, growers can cover farm roads with gravel, plant cover crops, and minimize tractor work on windy days.

Sources: National Center for Atmospheric Research (eo.ucar.edu) | Citrus Industry News (citrusindustry.net) | Environmental Protection Agency (epa.gov) | California Wind Energy Association (calwea.org)



Climate Control

Any gardener or farmer knows that planting crops outside depends wholly on weather patterns and conditions that must be suitable for plants to thrive. Climate-controlled environments, such as shade houses and greenhouses, allow farmers to take weather into their own hands—avoiding extreme weather conditions and creating the ideal temperature, humidity, and air flow for their crops.

Did you know?

Despite its name, greenhouses are not green. They are typically built with clear or opaque panels made out of glass or plastic.

Activity

What's Inside? Use evidence from the text to illustrate what's growing inside each type of climate-controlled structure. Use online search tools to help you accurately draw the crop inside.

Shade House

Hoop House

Greenhouse

Standards: CC ELA: RI.3-8.1, CA Visual Arts: 3.VA:Cr2.3, 6.VA:Cr2.3, 7.VA:Cr2.3

WOW! weather

One of the most well-known greenhouses in California is the Conservatory of Flowers, located in Golden Gate Park, San Francisco. Since 1879, the conservatory has housed rare and unusual plants for conservation and education. In 1995, extreme wind gusts of more than 100 miles per hour caused devastating damage to the conservatory, shattering 40 percent of the glass and destroying some of the rare plants inside.

Photo courtesy of sftravel.com

Sources:
UC Davis College of Agricultural and Environmental Sciences (caes.ucdavis.edu)
Conservatory of Flowers (conservatoryofflowers.org)
Penn State Extension (extension.psu.edu)

Activity

HOOP HOUSE Design Challenge

Design and test your own hoop house in this STEM challenge. A successful design will raise the temperature inside the hoop house at least three degrees.

- Possible Supplies -

√ chenille stems	√ plastic wrap	√ plastic bags
√ wax paper	√ cellophane	√ parchment paper
√ straws	√ bubble wrap	√ foil baking tray
√ thermometer	√ soil	√ seeds (optional)

1. Plan your design on paper. Consider the materials available and the goal to increase the temperature of the soil inside the hoop house.
2. Compare your design idea with those in your group. Choose the best design or make a new design incorporating the best components of each idea.
3. Construct a model using the materials provided.
4. Test your design by taking a temperature reading outside of the hoop house and comparing it to the temperature inside the hoop house.
5. Discuss which designs were successful and identify the design solutions that worked best.
6. **Bonus activity:** Plant seeds under the hoop house. Observe and compare plant development..

Standards: NGSS: PS.3.D, LS.1.C, 3-5-ETS1-1, MS-ESS1-2

TYPES OF Climate Control

Shade House

A shade house is a structure covered by mesh fabric which provides a mix of shade and light for shade-loving plants. Shade houses help reduce the temperature under the cover, while still allowing moisture and air inside. Crops typically grown in a shade house include orchids, ferns, spinach, summer lettuce, herbs, beans, and strawberries.

Hoop House

A hoop house is a temporary structure that is built in the field, over the growing area. The hoops look like a tunnel, with cylindrical hoops supporting a clear plastic cover. The ends are open to help regulate temperature in the growing area. Crops typically grown in a hoop house include raspberries, blackberries, vegetables, and herbs.

Green House

A greenhouse is a structure used to control climate with precision, allowing crops to grow year-round instead of just seasonally. Even in the harsh winter cold or intense summer heat, technology helps create the right climate inside the greenhouse. The most advanced systems are high-tech automated systems with controlled lighting, water, and ventilation. Crops typically grown in a greenhouse include cucumbers, ornamental plants, flowers, tomatoes, and winter lettuce.

Golden State

ALL DRIED OUT

A drought is a period of time when an area experiences below-normal precipitation. The lack of precipitation, either rain or snow, can cause reduced soil moisture, depleted groundwater, diminished stream flow, crop damage, and a general water shortage. During drought years, farmers and ranchers must carefully plan how to use their limited water supply in order to support their crops and livestock.

What do farmers do in times of drought?

Farmers will typically focus their water resources on the most economically beneficial crop to be produced. In some situations, farmers will choose to keep fields fallow in order to guarantee adequate water for higher value crops. For example, a farmer might reduce plantings of annual crops (tomatoes, corn, rice, cotton, and peppers) and focus on permanent crops (almonds, walnuts, citrus, and pistachios). If water is scarce and availability is unpredictable or if water quality is too poor, orchards may be removed and resources will be focused on annual crops.

WOW! weather

In 2021, the state recorded its second-driest water year on record. According to a UC Merced study conducted for the state, California farmers left nearly 400,000 acres of agricultural land unplanted last year because of a lack of water. The economic cost was high—the direct cost to farmers was $1.1 billion and communities lost nearly 9,000 agricultural jobs.

VIDEO

This 3-minute documentary produced for Scholastic Education gives a brief overview of how drought impacts all Californians, and why we must start adopting conservation practices today to ensure we have the water we need for the future.

Activity

Drip, Drip, Draw

In times of drought, we must all work together to conserve water. Think about your environment. Where do you see water being wasted? What can you do to help conserve our water supply? **Create a comic strip illustrating your idea for conserving water.**

Activity

How Dry Am I?

The severity of a drought is measured by the amount of precipitation in a given area compared to historical records. The U.S. Drought Monitor is a website that tracks the intensity of drought throughout the nation.

Use the website **droughtmonitor.unl.edu** to look up drought conditions in your county and write a paragraph describing the current conditions and at least two possible impacts to your community.

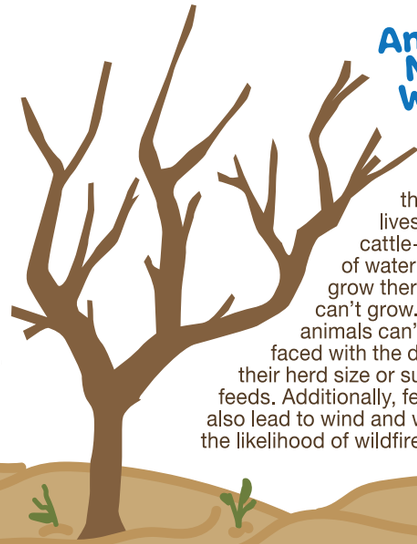
Standards CC ELA: W.3-4.7, W.3.8, W.5-8.2.D

Did you know?

Droughts are the second-most costly weather event after hurricanes.

Did you know?

As California faces another drought, goats are lending a hand—or hoof—to help reduce the risk of wildfires. In some of California's driest areas, goats are deployed to clear the land of dry vegetation, effectively reducing the fuel for future fires.



Animals Need Water Too

California's rangelands—open areas that are suitable for grazing livestock such as sheep or cattle—require a certain amount of water to support the plants that grow there. Without water, plants can't grow. When plants can't grow, animals can't graze. Ranchers are faced with the difficult decision to reduce their herd size or supplement with expensive feeds. Additionally, fewer rangeland plants can also lead to wind and water erosion and increase the likelihood of wildfires.

Sources: National Geographic (education.nationalgeographic.org) | UC Merced Water Systems Management Lab (wsm.ucmerced.edu) California Department of Water Resources (water.ca.gov) | Washington State University Extension (extension.wsu.edu)

SKY WATCH

Today, farmers rely on the data from hi-tech observational tools such as Doppler radars and weather satellites to help them predict the weather. Forecasts are often communicated to farmers and ranchers via weather service subscriptions and mobile apps, which are used to inform farming practices. But in the past, predicting weather was much simpler. Let's take a look at what farmers could learn from watching the sky.

WOW! weather

Funnel clouds are rotating columns of wind coming off clouds; if they touch the ground, they form tornadoes. In 2011, the National Weather Service estimated that at least five tornadoes touched down across Butte County and Glenn County, causing significant damage to agricultural land. In one case, an almond farmer lost approximately 25 percent of his crop when one of the twisters uprooted nearly 25,000 almond trees.

What does a cloud wear under his raincoat?

Thunderwear!

Did you know?

Clouds are created when water vapor, an invisible gas, turns into liquid water droplets. These water droplets form on tiny particles, like dust, that are floating in the air.

Activity

Cloud in a Jar

You don't have to go outside to observe the clouds—you can make your own cloud in a jar.

Here's what you need:

Glass jar with lid | Ice cubes | Hot (near boiling) water | Hairspray

Procedure:

1. Pour approximately one cup of hot water into the jar and gently swirl it around.
2. Turn the jar lid upside down and set it on top of the jar.
3. Place several ice cubes onto the lid, and wait 20-30 seconds.
4. Remove the lid and quickly spray hairspray into the jar.
5. Replace the lid with the ice still on top.
6. Observe and record what you see.

Standards
CC ELA: RST.6-8.3 NGSS: 5-ESS2-1, MS-ESS2-4

Draw what you observe during the activity

How are nimbostratus clouds different from cumulonimbus clouds?

Meteorologist Rob Carlmark has your answer on his kid-friendly weather feature, "Weather You Know."

Check this out!

40,000 ft
High
23,000 ft
Mid
6,500 ft
Low

Activity

Use the descriptions of each cloud type to label the illustration. Place the letter from each description in the correct box on the illustration to identify each cloud type.

Sources: Science Learning Hub (sciencelearn.org.nz) NASA Climate Kids (climatekids.nasa.gov)

Observing Clouds

One of the easiest ways to predict weather is to look at the clouds. There are many different types of clouds in the troposphere. Different clouds mean different types of weather.

High-level Clouds

A. Cirrocumulus clouds look like ripples of water on the surface of a lake. They are a sign of good weather and will often turn into a blue sky.

B. Cirrostratus clouds look like thin sheets that spread across the sky. They often appear 12–24 hours before a rainstorm or snowstorm.

C. Cirrus clouds are high altitude, wispy clouds. A few cirrus clouds may indicate fair weather, but increasing cover indicates an approaching warm front.

Mid-level Clouds

D. Altocumulus clouds appear as layers of small, puffy, gray clouds. When they appear on a warm, humid morning it may mean thunderstorms late in the afternoon.

E. Altostratus clouds form a grayish veil over the sun or moon. If they get darker and thicker, it is a sign that rain is on the way.

Standards CC ELA: RI.3-4.1, RI.3-5.7 NGSS: 3-ESS2-1

Low-level Clouds

F. Cumulus clouds are large, white, fluffy clouds known as fair-weather clouds. They often look like heads of cauliflower. If there is precipitation, it is light.

G. Stratus clouds are low clouds that form a fog-like layer and may produce drizzle. If they cover the morning sky, they will usually burn off and produce a fine day.

H. Stratocumulus clouds are long, puffy, and gray. They may produce light rain, but usually disappear by the late afternoon or evening.

Multi-level Clouds

I. Nimbostratus clouds are dark, thick clouds that can block out the sun. They indicate rain or snow lasting for several hours.

J. Cumulonimbus clouds are towering clouds that can forecast extreme weather including hail, heavy rain, thunder, and lightning. They often have a flat top.

Extreme Weather

Extreme weather events are unusually severe weather or climate conditions that can cause devastating impacts on communities and agricultural and natural ecosystems. Extreme events are often short-lived and include heat waves, heavy winds, freezes, heavy downpours, tornadoes, and floods. You might be surprised to know that all of these weather events can occur in the Golden State!

WILD FIRES

Nearly 85 percent of wildfires in the United States are caused by humans, while 15 percent are started by weather events, such as severe thunderstorms and lightning strikes. Wildfires often result in loss of life and damage to property, infrastructure, and ecosystems. Some of the largest and most destructive wildfires in California history developed in the summer of 2020, when wildfires burned more than 4.2 million acres across the state.

Livestock to the Rescue!

Researchers at the University of California are studying the impact of grazing livestock, such as sheep, goats, and cattle, on rangelands to reduce the severity of wildfires. They found that livestock grazing reduces plant material that can act as fire fuel, such as dead leaves and woody shrubs, more effectively than most mechanical methods, like mowing. In the recent fires, grazed rangelands burned less severely than areas not previously grazed.

Activity

Inferno Investigation

Conduct a short research project on a large fire in California's recent history.

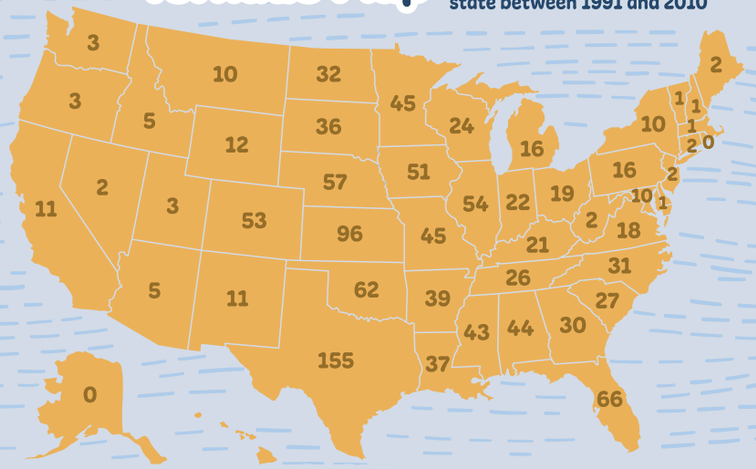
- How did the fire begin?
- Where was it located?
- How many acres did it burn?
- How did the fire impact California communities?
- How were farmers and ranchers affected?
- What was the estimated total cost of fire damage?

Standards CC ELA: W.3-8.7, W.4-8.9

Activity

Tornado Map

This map shows the average annual number of tornadoes by state between 1991 and 2010



Standards- CC Math: 3.OA.A.1, 3.NBT.A.3, 4.NBT.B.5, 6.SP.B.5 HSS Analysis Skills: K-5 CST 4

1. Which state has the highest average number of tornadoes?_____
2. Which states are least likely to experience a tornado?_____
3. What is the average annual number of tornadoes for California?_____
4. How many total tornadoes did California have during this period of time?_____

Floods

Despite California's recent years of drought, the threat of a severe flood is not only possible, but increasingly likely as we see changes in our climate. Regular floods have always occurred naturally in California and include some benefits, like recharging groundwater and supporting a variety of coastal ecosystems. But a severe flood—fueled by what scientists call a 'megastorm'—could affect the whole state and cause billions of dollars in damage. Flooding of this magnitude would turn California's bountiful Central Valley into an inland sea, causing major disruptions to the world's food supply.

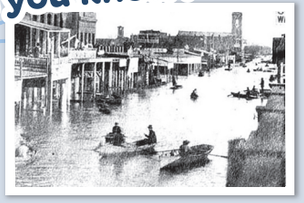
TORNADOES

A tornado is a narrow, violently rotating column of air that extends from a thunderstorm to the ground.

Their winds may top 250 miles an hour and can clear a pathway a mile wide and 50 miles long. Tornadoes can last from several seconds to more than an hour.

On farms and ranches, tornadoes can damage buildings, barns, machines, and tractors. They may uproot orchards, overturn hazardous materials, destroy crops, and hurt animals. Though tornadoes occur in every state, they are most frequent and intense in the southern part of the country.

Did you know?



The Great Flood of 1862 flooded Sacramento so severely that Governor Leland Stanford had to take a rowboat to his inaugural events in January 1862 State lawmakers also temporarily moved to San Francisco.

Imagine this...

Real life inspired third-grade student James Nelson's award-winning story, "Gardening through Tragedy." James' family lost their home in the 2018 Camp Fire, the most destructive fire in California's history. As his family relocated from Paradise to Orland, gardening helped his new house feel like home. Read the story by visiting **LearnAboutAg.org/imaginethis**

What is a tornado's favorite game?

Twister!

Sources: University of California Agriculture and Natural Resources (ucanr.edu/sites/fire/) National Oceanic and Atmospheric Administration (www.climate.gov) National Severe Storms Laboratory (nssl.noaa.gov) | California State History Museum (californiamuseum.org)

GLOSSARY

Accumulation: The process of water collecting in rivers, lakes, streams, oceans, and other bodies of water.

Annual: Happening once every year.

Aquatic: Living or growing in, on, or near the water.

Aquifer: A body of rock and/or sediment that holds groundwater.

Atmosphere: The gasses surrounding the earth or another planet.

Automated: Carried out by machines or computers.

Bloom: The period or state of flowering.

Climate: The long-term pattern of weather in a particular area.

Conserve: To use carefully or sparingly, avoiding waste.

Cover crop: A crop grown for the protection and enrichment of the soil.

Crater: A cavity or hole on any surface.

Crop protection material: Substances applied to crops in order to manage plant diseases, weeds, and pests.

Cylindrical: In the shape or form of a cylinder.

Dam: A barrier built across a river or stream to contain water.

Debris: The scattered remains of something broken or destroyed; rubble or wreckage.

Divert: To cause someone or something to change course.

Doppler radar: A specialized radar that measures the direction and speed of objects.

Emitter: A nozzle fitted onto a pipe or hose that delivers small amounts of water directly to the plant roots.

Erosion: The slow wearing away of land.

Fallow: Land on a farm that has been plowed but not planted for one or more seasons.

Fertilizer: Any natural or manufactured material added to the soil to supply one or more plant nutrients.

Freshwater: Water that contains minimal quantities of dissolved salts.

Fruit Set: The process of a flower forming a berry.

Groundwater: Water that is stored under the surface of the earth in aquifers.

Habitat: The environment where an organism lives.

Hazardous: Risky, dangerous.

Humid: Dampness, especially of the air.

Inaugural: Marking the beginning of a politician's term of office.

Infrastructure: The basic systems and services, such as transportation and power supplies, that a country or organization uses in order to work effectively.

Insulate: To cover something with a material that protects it from extreme temperatures.

Irrigate/Irrigation: The application of water to the land used in agriculture to help crops grow.

Meteorologist: A scientist who studies the atmosphere and its phenomena, including weather and climate.

Opaque: Not able to be seen through.

Ornamental: Plants that are valued for their beauty rather than usefulness.

Permanent crop: Plants which last for many seasons, rather than being replanted after each harvest.

Perpendicular: Objects that intersect at a right angle.

Photosynthesis: The process in which leaves capture light and convert it to plant food.

Pollination: When pollen transfers from the anther to the stigma of a flower.

Precipitation: Moisture such as rain, snow, hail, sleet, falling from the atmosphere.

Precision: The quality of being exact and accurate.

Ration: The amount of feed an animal receives in a 24-hour period.

Replenish: To fill up again.

Satellite: An object placed in orbit in outer space in order to collect information.

Sea level: A method of measuring elevation in relation to the surface of the sea.

Sediment: Solid material that is moved and deposited in a new location.

Spillway: A passage for surplus water from a dam.

Temperate: Mild or moderate.

Troposphere: The first and lowest layer of the atmosphere of the Earth.

Water vapor: Water in the form of a gas resulting from heating water or ice.

Well: A deep hole drilled into the earth to obtain water.

Wind turbine: A device that converts the kinetic energy of wind into electrical energy.

Activity

Choose two glossary words and use both in a complete sentence.

Write your sentence in the space provided.

Standards
CC ELA: L.3.2G, L.3.4D, L.3.5B, L.4.2D, L.4.4C, L.5.2E, L.5.4C, L.6-8.4C, L.6-8.4D

1.

2.

What's Growin' On? Weather Wise

Scan this QR code

or visit LearnAboutAg.org/resources/wgo/

- To find the answers to activities in this newspaper.
- To order additional free copies for your teaching team, classroom, or ag literacy event.
- To download a teacher's guide that features extension ideas that will engage students with the content on these pages.

Resources

California Department of Water Resources
water.ca.gov/water-basics

California Grown
californiagrown.org

Department of Water Resources
water.ca.gov

NASA Climate Kids
climatekids.nasa.gov

National Center for Atmospheric Research
eo.ucar.edu

National Ocean Service
oceanservice.noaa.gov

United States Geological Survey
usgs.gov

Water Education Foundation
watereducation.org

We all know the four seasons: winter, spring, summer, fall.

But what does it mean to eat "seasonal" produce?

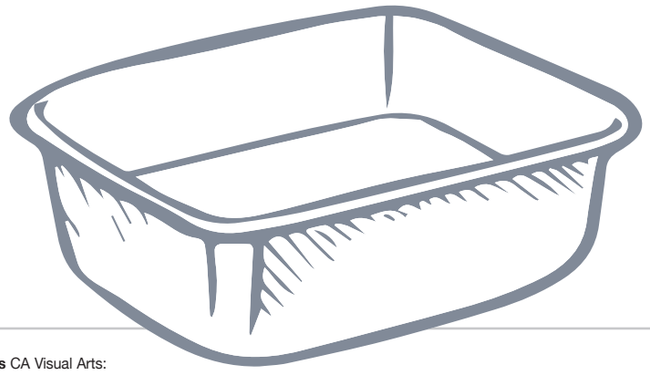
Seasonal produce refers to fruits and vegetables that are at peak production locally. For example, although you may see avocados in stores all year round, it's important to know that California avocados are in season from spring through early fall.

Here is a simple checklist that will lead you to finding seasonal produce in the grocery store:

- **Look for a "California Grown" label:** Because of diverse microclimates and an excellent water transportation system, California farmers produce more than 400 different crops and livestock commodities. If the produce you're looking for is available with this label, it's likely in season.
- **Check the price:** In peak season, products will flood the market, driving down prices. Sales often lead consumers to in-season produce.
- **Visit your farmers market:** Farmers markets generally sell local produce, meaning the fruits and vegetables available at the market are in season for your area.

Activity

Fill the package with a fruit or vegetable that is currently in season. Be sure to include a produce label that tells consumers that it is locally produced and in season.



Standards CA Visual Arts: 4.VA:Cr1.2, 6-8.VA:Cr2.1, 7.VA:Cr2.3

About California Foundation for Agriculture in the Classroom

We are a 501(c)(3) nonprofit organization that provides educators with free standards-based resources about California agriculture. Our mission is to increase awareness and understanding of agriculture among California's educators and students. Our vision is an appreciation of agriculture by all.

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