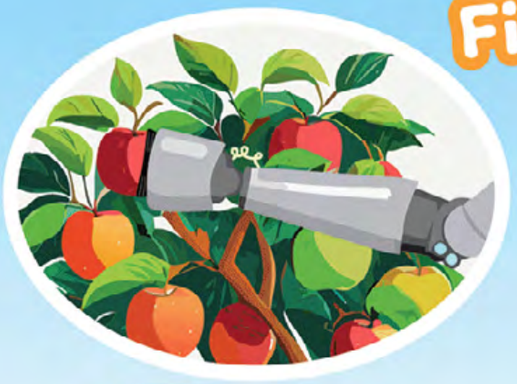
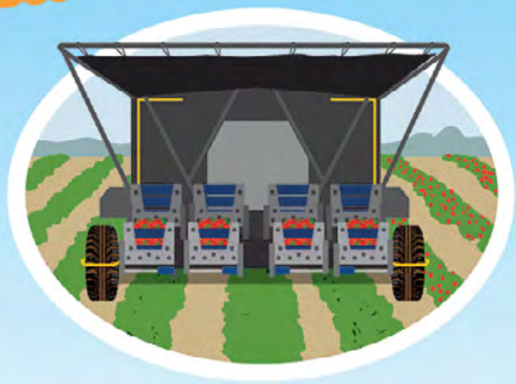
22nd Edition

What's Growin' On?

Fields of Innovation





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Fields of Innovation:
California Farmers Feeding the World

The global population has grown to over 8 billion, making the challenge of feeding everyone nothing short of monumental. But fear not! Our student newspaper is here to unveil the incredible innovations that farmers are embracing to meet this tremendous demand.

Within these pages, discover the magic of smart farming, where technology and tradition come together to help California farmers and ranchers produce more than 400 different commodities, all while conserving our precious resources. Today's agriculturalists use cutting-edge gadgets and data to make savvy decisions for their crops. With these tools, they're learning to maximize yields and ensure there's plenty for everyone. This newspaper is your ticket to the action-packed world of modern agriculture. Let the journey begin!

Read All About It!

Welcome to the 22nd edition of *What's Growin' On?*—an annual resource published by the California Foundation for Agriculture in the Classroom. For over two decades, we've been on a mission to ignite the curiosity of students, guiding them on an exploration of the countless ways agriculture impacts our daily lives.

In this year's edition, *Fields of Innovation,* we draw inspiration from the extraordinary collaboration within the agriculture industry. Farmers, engineers, scientists, ranchers, builders, and computer programmers unite to propel innovation, addressing the challenge of feeding and clothing our ever-expanding world.

Crafted by educators and reviewed by agriculture industry experts, each edition of *What's Growin' On?* 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 touring California's fields of innovation!

Discover the amazing world of careers in agriculture!

Dive into 40 short, inspiring videos, each under four minutes long, where experts share their journey. Meet a plant scientist, a cheese manager, an algae farmer, and more! Learn their stories, and watch on your own or with your class. Scan the QR code and embark on the thrilling adventure of agriculture and technology!

Tractor Tech

In the past, farmers used horses and hard work to plow fields. In the early 1900s, inventors like Henry Ford introduced gasoline-powered tractors, making farming faster. Now, something even cooler is happening: autonomous tractors! These smart machines can perform farming tasks on their own, without a driver. It's like having a robot helper in the fields, making farming easier and more efficient!

Autono-WHAT??

An autonomous (aa-tah-nah-muhs) tractor is a piece of self-driving farm equipment that performs its duties without an operator sitting in the cab. They don't need a person to drive them because they can think and make decisions on their own.

How Does It Work?

Let's explore the incredible technology that drives autonomous tractors:

Global Positioning System (GPS) Guidance:

Tractors talk to satellites, pinpointing their exact location with amazing precision, accurate to within fractions of an inch.

360° Cameras:

Think of these cameras as the tractor's eyes. They see all around, just like you do! These cameras spot obstacles, measure distances, and process images quickly so that the tractor can perform its tasks.

Radar Sensors:

Special sensors detect objects and obstacles nearby. This safety feature helps the tractor make lightning-fast decisions.

Artificial Intelligence (AI):

Using input from the tractor's cameras, sensors, and GPS unit, its AI brain makes smart choices, ensuring it works smoothly on the farm.

SCAN & SEE

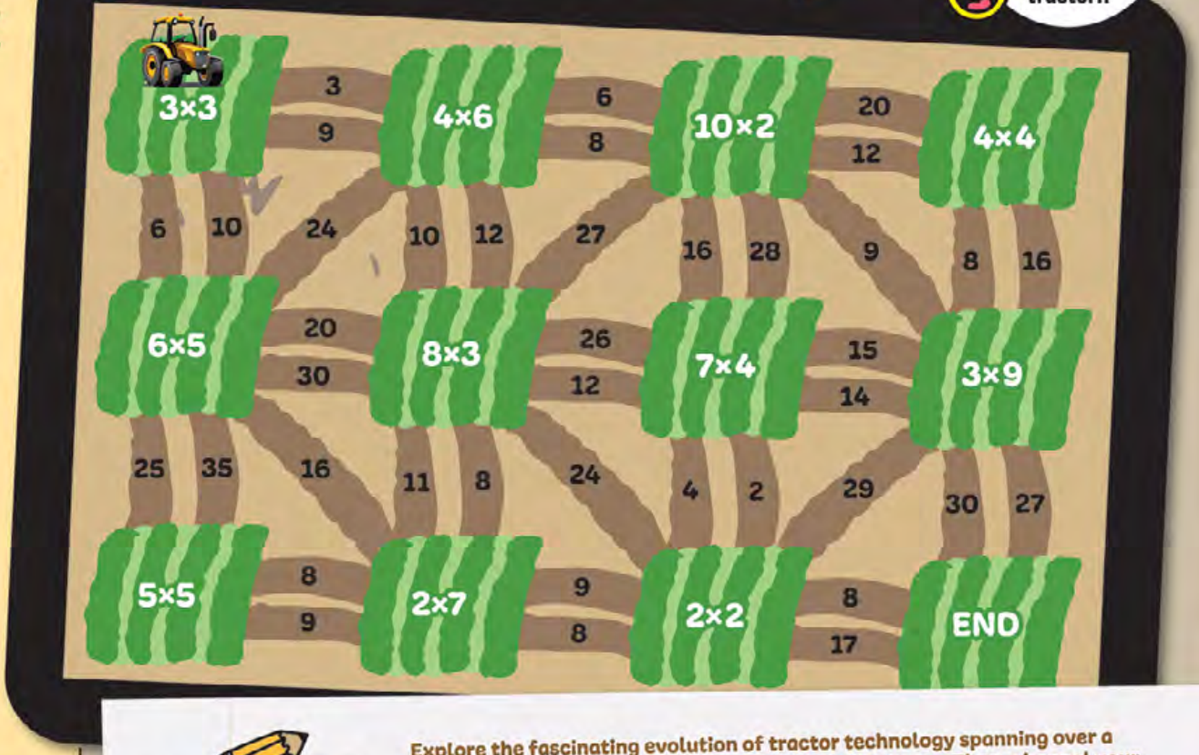
Step into the future of farming with John Deere's autonomous tractor. Watch as a swipe on a smartphone brings this smart machine to life, allowing farmers to focus on other tasks while monitoring its progress remotely. It's farming innovation at your fingertips!

The A-Maze-ing GPS

Activity

Autonomous tractors can be programmed to follow a specific path using GPS technology. Join the fun on the farmer's tablet, guiding the tractor along the route by solving math problems. Start at the tractor icon, find the correct answer, and shade the path until you reach the end of the field.

Standards: CC Math: 3.OA.7; 4.NBT.5



Activity

Explore the fascinating evolution of tractor technology spanning over a century! Use research tools to uncover key milestones. Then, channel your creativity onto a separate sheet, creating a timeline that showcases at least five epic moments in tractor history.

Here are a few examples:

1. Charles W. Hart and Charles H. Parr created the first two-cylinder gasoline tractor in the United States.
2. Model B John Deere tractors were designed with electric starts, lighting, rubber tires, and increased horsepower.
3. Silsoe Research Institute engineers developed a picture analysis system for managing a miniature driverless tractor designed for vegetable and root crops.

Standards: CA History-Social Science: HSS Analysis Skill (1-5) CST 1, 8.12; CC ELA: RI.3.5, RI.5.7

Sources: Bear Flag Robotics (www.bearflagrobotics.com), NASA (www.nasa.gov), Monarch Tractor (www.monarchtractor.com)

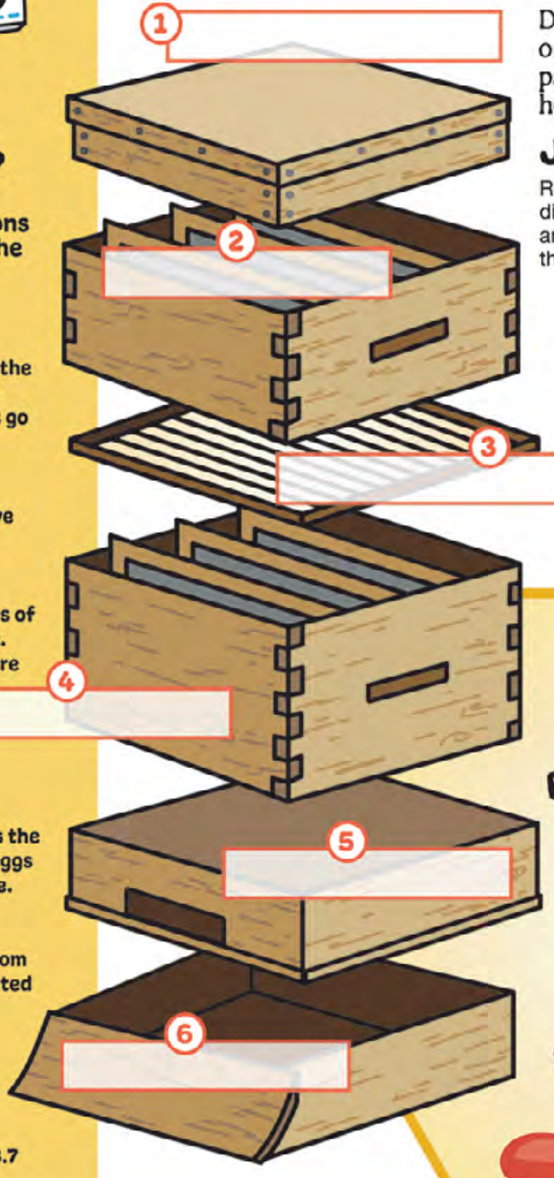
BUZZING into the Future

Did you know that bees and other pollinators help make a lot of the food we eat? In fact, one out of every three bites of food is possible because of them! Bees are an important part of our ecosystem and scientists are working really hard to keep them safe and healthy. They use creative ideas and new technology, all beginning right in the hive!

Activity

What's Inside the Hive?

Use the definitions below to label the hive diagram.



Bottom Board: The bottom part of the bee house. It has an opening where bees go in and out.

Hive Body: Where most bees live and make honey.

Frames: Bees build neat rows of cells inside the hive. These cells are where bees store honey, raise baby bees, and store food.

Queen Excluder: A barrier that keeps the queen from laying eggs in the honey storage.

Lid: Protects the hive from weather and unwanted visitors.

Hive Stand: Lifts the hive off the ground.

Standards: RST.6–8.7

Just follow the Bee-bot

Researchers are studying how robot bees can direct other honey bees toward nectar and pollen and also help navigate them away from areas that contain pesticides or other obstacles.

SCAN & SEE

Learn how honey bees help our food grow and why they need our help to stay healthy. Watch this video from CNN to find out how new inventions are helping beekeepers protect honey bees and our food.

What's the Buzz on Bee Tech?

Hive Monitoring: With the power of advanced sensors, including microphones, beekeepers can keep a watchful eye on their hives. Sensors measure everything from temperature and humidity to bee sounds and hive populations.

Hive Supplements: Hive supplements are "bee feed" that beekeepers give to bees when there aren't many flowers around. The newest supplements can help control pests, increase foraging, and improve colony health.

Hive Vaccination: Scientists have found a way to protect bees from bacteria that causes the bee disease called American Foulbrood. Instead of a shot like you get at the doctor's office, they mix the vaccine into a sugar patty that the queen bee eats.

Activity

Busy Bee Activit-ee

Use toothpicks and marshmallows to make a 3-D beehive cell. Write down each step. Give instructions to someone to see if they can build it too! What 2-D shapes did you use to make your model? How many faces, edges, and vertices did it have?

Standards:
CC Math: 5.G.4, 6.G.4

Why did the bee get good grades in school?

It was always "bee-hiving" itself!

Did you know?

Bees are transported all over the United States to pollinate crops and live in warmer climates during cooler months. A semi-truck towing a flatbed trailer can haul more than 22 million honey bees at a time!

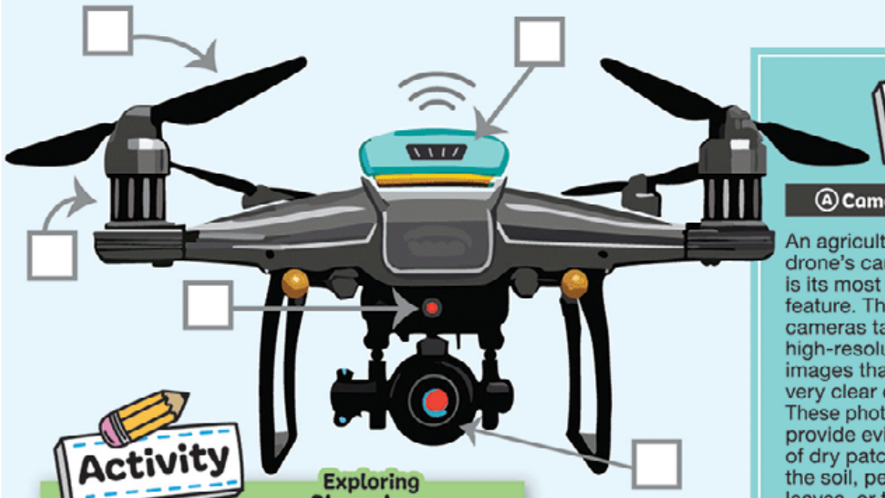
Sources: The Pollinator Partnership (www.pollinator.org), Hyper Hyve: The Future of Beekeeping (www.hyperhyve.com), Consumer Technology Association (www.cea.tech)

Ag from Above

Drones have become important tools in modern agriculture. They zip through fields with ease, capturing high-quality images that help farmers and ranchers make decisions about how to grow their crops and keep them healthy. Drones can do many different jobs on the farm, like adding nutrients to the soil, planting seeds in just the right spots, watching over animals, and making sure the plants get enough water. Drones help from above while farmers continue to work hard on the ground.

Why did the farmer call his drone a snob?

It looked down on people's farms!



Activity

Drone Anatomy

Carefully examine the description of each drone feature. Locate the corresponding feature on the provided diagram and accurately mark the designated space with the correct letter.

Ⓐ Camera

An agricultural drone's camera is its most useful feature. These cameras take high-resolution images that have very clear detail. These photos may provide evidence of dry patches in the soil, pests on leaves, or the location of livestock herds.

Ⓑ Rotors

Some drones have rotors, like helicopters, while others have fixed wings, like airplanes. Rotor drones are more maneuverable than fixed-wing drones. They can hover, fly closer to the ground, and need less room to take off and land.

Ⓒ Sensors

Sensors can measure things that are not easily seen, like thermal sensors that can detect an animal's temperature, or moisture sensors that can measure the amount of water in the soil.

Ⓓ Bodies & Motors

Drone bodies are made from light materials, such as carbon fiber. These materials are strong but not heavy. Agricultural drones have battery powered electrical motors that must be recharged often.

Ⓔ GPS

Like the phones we use every day, drones are equipped with a global positioning system (GPS). An antenna (visible or hidden) communicates with satellites to determine the drone's exact location and help the operator plan a flight path, track its movement, and program a landing location.

Standards: RI.3-8.1, RST.6–8.7

Activity

Exploring Dimensions:

Math with Drones

Imagine you're a farmer monitoring a rectangular field. Given the field's dimensions, determine the perimeter and area of the flight zone.

Field Dimensions (in feet):
Length: 454 feet | Width: 192 feet

Perimeter:_____ Area:_____

Now, let's imagine the drone's flight path over the field. Using a piece of graph paper, draw a model of the rectangular field, and then plan the drone's flight path.

1. On the graph paper, draw a rectangle to represent the field. Use one square on the graph paper to represent 20 square feet.
2. Start at one corner of the field, and draw the path the drone will take as it flies over the entire area. Assume the drone can monitor a 100ft. wide path.
3. Count the number of squares your drone's flight path covers to find the total distance it will fly.

SCAN & SEE

Explore how drones take to the skies to assist ranchers in watching over their cattle. From capturing the very first steps of a baby calf to herding cattle and checking on their well-being, drones are there every step of the way.

LEGO® Drone Design Challenge

Get ready to embark on an exciting journey into the world of drones. In this activity, you'll become a drone designer and builder using LEGO bricks.

STEPS

1. **Gather your LEGOS.**
2. **Sketch your drone on paper. Include all the important features listed above.**
3. **Follow your design and construct your drone.**
4. **Compare your creation with your classmates. Identify the coolest design components that would benefit a farmer or rancher.**

Standards: NGSS: 3-5-ETS1-1; MS-ETS1-1

Did you know?

Did you know drone pilots need Federal Aviation Administration (FAA) certification to fly in the real world? These certifications include serious rules for staying safe, especially since drones share space with big planes like crop dusters. Think of it as having a driver's license, but for the air!

Sources: Rose, Simon. Agricultural Drones. Capstone Press, 2017. USDA, National Institute for Food and Agriculture (www.nifa.usda.gov), California Invasive Plant Council (www.cal-ipc.org).

Right on Target

With precision agriculture, farmers use smart data and technology to make sure their farming practices are right on point. This not only helps them grow our food, fiber, and flowers, but also helps them take care of our environment, making sure everything hits the mark!

Laser Light Show

Activity

Creating a laser light show is super easy and fun. Remember, be safe and never point the laser at someone's eyes.

1. Gather your materials. You'll need a laser pointer (Class 2 or 3A), a prism, and a darkened room. You also need a light-colored wall.
2. Point the laser at the wall. You'll see a straight beam of light.
3. Hold the prism in front of the laser beam. Watch the light bend and make colors!
4. Move the prism until the colors form a spot on the wall.

Observe how laser light behaves compared to diffused light, like from a flashlight. Think about how lasers could be used in farming. Could they help with precision planting, weed control, or pest control? Discuss the exciting possibilities of lasers in agriculture!

Standards:
4-PS4-2; RST.6-8.3

The Tools

Smart Lasers

Researchers are studying if lasers can target specific pests, like insects and weeds, without hurting the good bugs and plants. It's like a high-tech game of tag, where lasers zap only the pests, leaving the rest of the ecosystem unharmed.

Smart Maps

Global Positioning Systems (GPS) helps farmers grow crops better. It's like a smart map for fields. Farmers use it to plant seeds, apply fertilizers, and spray pesticides accurately. With GPS-guided tractors, everything lands right on target. This smart farming saves resources and makes farming efficient!

Smart Sensors

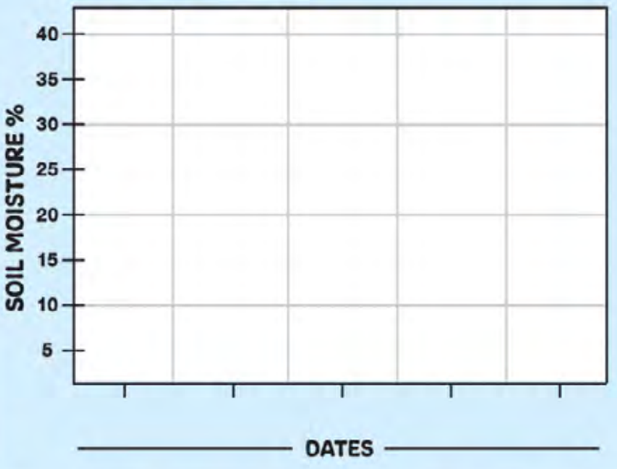
Crop monitoring sensors give instant information, so farmers can keep an eye on their fields and make smart choices based on data. For instance, sensors can tell how wet the soil is, helping farmers know the best time to water their crops. Plus, these clever sensors often send all their data wirelessly to a farmer's cell phone or tablet, so they instantly know if there's a problem in their fields.

Activity: Getting Water Wise

Welcome to Soggy Farms, where we make smart water choices! Join our mission to conserve water by plotting the readings from a soil moisture sensor on a line graph. Connect the dots to track water moisture trends over time. As a farmer, what concerns would you have and how might you improve your irrigation schedule?

Soil Moisture Sensor Readings at Soggy Farms

DATE	Moisture Reading (% of water in the soil, by volume)
July 3	20%
July 17	35%
July 31	15%
Aug 14	5%
Aug 28	20%



Did you know?

"See and Spray" technology uses computer vision and machine learning to apply herbicides only as needed. This groundbreaking innovation empowers growers to reduce herbicide use by an impressive 77 percent, promoting sustainable and efficient farming practices.

SCAN & SEE

Lasers, robots, and data, oh my! Imagine a robot that's super smart—it uses AI technology to find specific weeds, zap them with lasers, and gather essential data as it works. You can watch this incredible robot in action in a video featured on NBC News.

Sources: University of California ANR (ucanr.edu), CropX (cropx.com), Carbon Robotics (carbonrobotics.com), John Deere (www.deere.com)

Processing Plant Detectives

Welcome to the exciting world of agricultural detectives! After the crops have been harvested, technology plays a key role in preparing food for the grocery store—whether that food arrives fresh, in cans, in the freezer section, or in snack-sized bags. The mission? To ensure consumers have access to the safest and highest quality fruits, nuts, and vegetables.

A-peeling Innovations

Attention french fry, pasta sauce, and jam eaters!

These foods all require fruits and vegetables to be peeled after harvest. This might seem like a simple task, but behind the scenes, innovative technologies are at work, making the process efficient and sustainable. One such cutting-edge method is steam peeling—a gentle and effective method that uses the power of steam to loosen the skin or outer layers of fruits and vegetables.

Draw an icon to illustrate each benefit of steam peeling:

Efficiency

Steam peeling is a really fast way to prepare food in big amounts for places like schools or hospitals.

Reduced Waste

Steam peeling only removes the outer layer while keeping all the good stuff underneath. This helps make sure we don't throw away a lot of food.

Energy Efficient

Steam peeling doesn't require as much energy as the old ways of preparing food. Saving energy reduces air and water pollution and conserves natural resources.

Standards: CC ELA: RI.3-8.1; 7.VA:Cr2.3

What do you call a potato that is reluctant to jump into a peeler?

A hesi-tater!

SCAN & SEE

Learn all about Pacific Coast Producers, experts in canning fruits and tomatoes. This video gives you a peek into their processing lines and the cool technology they use to keep things running smoothly. See if you can spy at least three different innovations that play a crucial role in their day-to-day operations.

Standards: CC ELA: SL.3-5.2

Sorting Machines

Equipped with high-tech detective gadgets like powerful lasers, specialized cameras, and super smart software, sorting machines work like true detectives. They are always on the lookout for imperfections, removing everything from foreign material (like rocks and sticks) to defective nuts and produce that have been damaged by pests or machines.

Activity

Welcome to Kernel Sherlock's Almond Processing Plant!

A load of almonds has just arrived at the processing plant. With 50,000 pounds of almonds on board, our job is to sort the nuts quickly and efficiently. Solve the mystery by determining how many almonds remain after being processed.

X-Ray Scanner

First up, the X-ray scanner! This machine uses x-ray vision to detect foreign material like glass, stones, plastic, and metals. Any unwanted material is removed from the load with the help of air ejectors, which use a strong and precise burst of air to direct unwanted items into a waste bin. Kernel Sherlock finds that the x-ray machine removed 3% of the load.

Chute Sorter #1

With the help of cameras, lasers, and pulsed LED lights, this machine "sees" each almond that falls through its chute. Pulsed LEDs use special light pulses to detect subtle color differences in nuts. Defective nuts are sorted into a special bin for non-food purposes, such as cosmetics and hair products. Kernel Sherlock discovers that the chute sorter removed 5% of the load.

Chute Sorter #2

The nuts go through a second chute sorter for additional quality assurance. This time, Kernel Sherlock observes that the machine removed 135 pounds of almonds.

Did you know?

Freshness is preserved in canned fruits and tomatoes, which are meticulously packed within mere hours of being harvested at the peak of ripeness.

Now it's time to solve the mystery! How many almonds were left after processing?

Standards:
CC Math: 6.RP.3c, 6.NS.3

Sources: TOMRA (www.tomra.com/en/food); Produce Processing (produceprocessing.net); Pacific Coast Producers (pacificcoastproducers.com)

Moo-dern Marvels

Innovations in the Dairy Industry

Ever wonder how milk, cheese, yogurt, and butter end up in your kitchen? Well, it's all thanks to the dairy industry. Many dairy producers have embraced technology to make the whole process run smoothly. They use cool gadgets and smart methods to collect milk from cows efficiently, ensuring that it's fresh and nutritious. So, whether you're enjoying a glass of milk, a cheesy pizza, or a delicious yogurt snack, know that the dairy industry is using innovative tools to make sure we all get the best dairy products possible!

Did you know?

In the Golden State, dairy products reign supreme! California's dairy industry is udderly fantastic, making dairy the number one agricultural commodity in the state.

How does a dairy farmer keep track of their herd's data?

They use a COWputer!

Sources: Animal Ag Alliance (animalagalliance.org), Hoard's Dairyman (hoards.com), UC Davis Animal Science (animalscience.ucdavis.edu), The Dairy Alliance (thedairyalliance.com), California Department of Food and Agriculture (cdfa.ca.gov), California Milk Advisory Board (realcaliforniamilk.com)

Udderly Automated

Let's discover the world of robotic milkers!

These machines help with tasks like cleaning and monitoring cows during milking, making the whole process more efficient. The robots send notifications straight to the farmers' phones to keep them updated on their cows throughout the day and night.

1

Each cow wears an electronic collar that allows the robotic system to identify her. It also helps keep track of eating behaviors, health, and activity.

2

They enter the milking stall at their convenience, where a robotic arm cleans teats, attaches milking cups, and records data.

3

Once a cow is finished being milked, usually 3-5 gallons later, the cups detach automatically. The cow's teats are sanitized before she returns to the pasture or barn.

4

The milk is filtered and pumped into tanks, where it is cooled and stored for one to two days. The milk is picked up by a tanker truck and transported to a processing plant, ensuring fresh and quality dairy products reach our homes.

Activity

Powered By Poo

Cows are exceptional at producing poop—called "manure" in the dairy business. But here's the genius part: instead of letting the manure break down on its own and release gases into the atmosphere, some dairy farmers are using methane digesters. These machines capture the gas and turn it into renewable energy. The energy created is used to power communities with electricity and heat, and provide fuel for vehicles. So, next time you see a cow, remember they're not just mooing around; they're part of the energy revolution!

Unscramble the dairy words below to solve the riddle.

EIC AMRCE

GUORYT

TUEBTR

IKML

EACRMRE

RNASPAEM

At the dairy, my stink you can't measure, but turned into gas, I'm a green-energy treasure.

ANSWER:

Activity

A Tale of Two Cows

Meet two cows, Bella and Maple.

We're investigating how much milk they make each day with robotic milkers. Examine the table below and complete the graph by calculating the gallons of milk they produce each day. Keep in mind that Bella and Maple can decide when to use the robotic milker, resulting in different milking frequencies on different days. Let's analyze the data to see their daily milk production patterns!

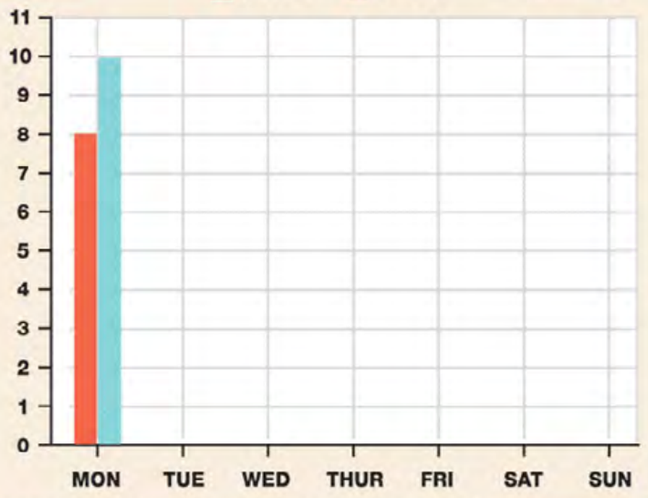
GALLONS PRODUCED

	BELLA	MAPLE
MON	3,3,2	3,7
TUE	4,5	3,4,4
WED	5,5	2,4,5
THUR	4,5	7,2
FRI	5,2,4	5,3,2
SAT	7,4	4,4,3
SUN	5,5	3,2,5

Standards: CC Math: 3.MD.B.3, 4.MD.A.2, 5.NBT.B.5, 8.SP.A.2

Questions:

1. Look at the graph. Which cow produced the most milk more often?
2. On which days did Bella make more milk than Maple? How much more did she make on those days?
3. Calculate the average daily milk production for both Maple and Bella. Which cow had a higher average?
4. Challenge: Imagine there are 800 cows on the dairy, all producing a similar amount of milk. Calculate how many gallons of milk are produced on the farm each day.



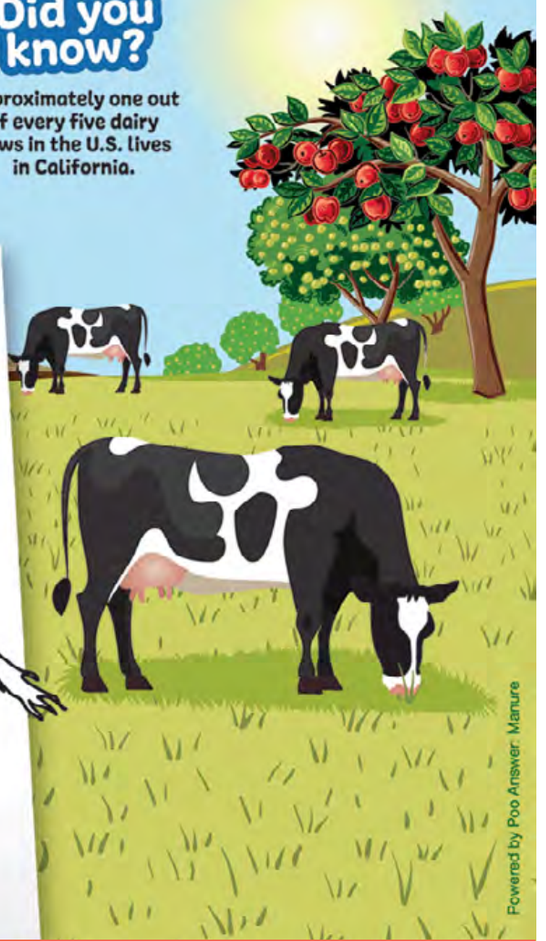
Clever Containers

Dairy companies are moving towards more environmentally friendly packaging. While some companies are investing in plant-based, renewable cartons, others are using recycled materials to make a big impact. California company, Clover Sonoma, is the first U.S. milk brand to introduce a post-consumer recycled milk jug. Crafted with 30% recycled household plastic, this innovation marks a significant step in reducing environmental impact and promoting responsible packaging practices.

California dairy families have been decreasing their carbon "hoofprint" for decades by producing more milk with fewer cows and using clean energy sources. Some farmers are even feeding cows seaweed to help their burps (pardon me!) produce less methane, which is taking greenhouse gas reduction to the next level.

Did you know?

Approximately one out of every five dairy cows in the U.S. lives in California.

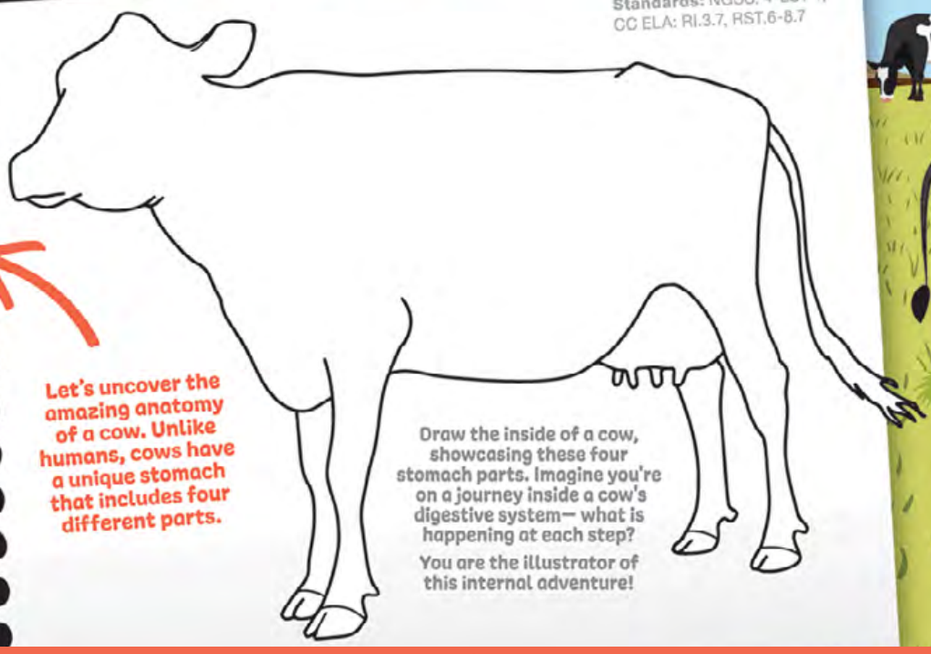


Activity

Got Guts?

1. The **rumen** is like a big mixing bowl where the food goes first. Microorganisms inside mash it up, getting it ready for the next steps.
2. Next is the **reticulum**, a sorting station that helps the cow figure out what's good to keep digesting and what needs more work.
3. The **omasum** is like a giant sponge. It squeezes out water from the food, making it easier for the cow's tummy to handle.
4. Finally, there's the **abomasum**, the true stomach. This is where special juices break down all the good stuff, turning it into energy for the cow.

Standards: NGSS: 4-LS1-1, CC ELA: RI.3.7, RST.6-8.7



Let's uncover the amazing anatomy of a cow. Unlike humans, cows have a unique stomach that includes four different parts.

Draw the inside of a cow, showcasing these four stomach parts. Imagine you're on a journey inside a cow's digestive system— what is happening at each step?

You are the illustrator of this internal adventure!

Powered by Poo Answer: Manure

Harvest Hacks

Harvest hacks are making agriculture safer, more efficient, and more reliable. Modern machines used for harvesting crops are equipped with technology such as advanced sensors, software, and optical eyes. In some cases, robots use machine learning to make decisions and complete the hardest tasks without the help of humans.

Throughout California, machines are increasingly used for harvesting fruits and vegetables.

- Sometimes there are not enough workers to pick the crops when it's ready.
- Picking crops by hand is hard work.
- Machines help pick fruits and veggies quickly so they don't go to waste.

Advanced.farm is a cutting-edge tech company located in the Sacramento region.

In this video, you will see some of the amazing technology they've created, including robots for harvesting apples, tree fruit, and strawberries.

Harvest Hunt

A tomato harvester is gathering tomatoes. The conveyor belt carries tomatoes, leaves, stems, debris, and soil. Only the red, ripe tomatoes are saved. Use the letters from these ripe tomatoes to unscramble and discover a special technology that "sees" what is grown but is not made of flesh and bone.

Can you guess the mystery technology?

_ _ _ _ _ _ _ _ _ _ _

Berry Picking Prototype

Hey there, young inventors! Your task is to create a berry picker prototype that collects berries gently and effectively. Use this space to brainstorm ideas and draw your design. Once you're ready, use classroom materials to build your machine and test it on different berries.

That's not all! Imagine you're presenting your invention to an ag tech company. How would you convince them to buy your berry picker? Get ready to be "berry" brilliant and show off your awesome invention skills!

Standards: NGSS: 3-5-ETS1-1, 3-5-ETS1-2, MS-ETS1-1, MS-ETS1-2; ELA: SL.3.1, SL.4.1, SL.5.1, SL.6.1, SL.7.1, SL.8.1

Types of Mechanical Harvesting

Selective Harvesting

Selective harvesting is a way of collecting crops where only certain fruits or vegetables are gathered, leaving some of the crop to grow for future harvests.

Since apples can be easily bruised, they demand careful and selective harvesting. Robotic systems, with soft grippers, vision technology, and AI algorithms, are currently being tested in the field to see if they can identify ripe fruit and harvest it gently.

Whole Crop Harvesting

Whole crop harvesting is a way of collecting crops where every plant in the field is removed and only the ripe produce is kept.

A tomato harvester pulls up whole plants and shakes them to collect ripe fruit. The machine uses an optical eye to quickly separate bad fruit (along with rocks and sticks) from good fruit, allowing only the good to move into waiting bins that will eventually be transported to processing plants.

Sources: WECO (www.wecotek.com), Advanced Farm Technologies, Inc. (advanced.farm), UC Davis Plant Sciences (plantsciences.sf.ucdavis.edu)

How's it Harvested?

Whole Crop	Selective
Processing tomatoes	Apples
Potatoes	Strawberries
Peppers	Peaches

Harvest Hunt Answer: Optical Eye

Petals of Progress

The floral industry revolves around growing and caring for flowers and foliage, creating beautiful arrangements, and selling them to bring joy and beauty to people's lives. This page is dedicated to the industry's progress—how it is moving forward and continuously improving. Recent innovations are enhancing current floral practices, making them even better for consumers, producers, and the environment.

Petal Potion

Get ready to become a flower scientist and witness the wonders of your very own "petal potion" in action!

Research and discover which ingredients from your home can help flowers stay fresh and beautiful longer. Create your very own flower preservative solution, and then become a scientist as you design and carry out an experiment to see how it compares to plain water in keeping cut flowers vibrant and healthy.

Standards: NGSS: 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3; MS-ETS1-1, MS-ETS1-2, MS-ETS1-3

My Petal Potion

Ingredients: _____

Instructions: _____

Floral Freeze

Some of the most important advancements in the floral industry are related to transportation. It can take up to five weeks for flowers from other countries (like Colombia and Ecuador) to arrive in the U.S. via cargo ship. Consistent temperature is essential for flower transportation. The ideal environment is as close to freezing without actually freezing the flowers. Advancements in refrigerated sea containers keep flowers at a consistently low temperature, so that upon arrival, flowers are in the same condition as when they left.

Boat

The coldest way to transport flowers. It can take a long time for flowers to reach their destination. Technologies to improve ship speed are on the horizon!

Refrigerated Truck

Trucks take flowers all over the U.S., but when the doors open, the temperature inside can change. New intelligent temperature control systems will help keep the temperature just right.

Airplane

The quickest way to transport flowers, but temperature is not controlled. In the future, electric airplanes may help reduce the environmental impact of shipments.

Flower Power Crossword

Use the information on this page and the clues below to complete the crossword.

Down

1. The slowest method for transporting imported flowers from afar
2. Microbe-fighting floral ingredient
3. Key factor in keeping flowers fresh during transit
6. Greenery in a bouquet
7. Quick flower delivery, but no temperature control

Across

4. Uncommon hue in flowers
5. Common vehicle for moving flowers across the country
8. The ultimate arrival point for blooms

Standards:
CC ELA: RI.4.7, RI.5.1, RI.5.4, L.4-5.6

Ever wondered how those beautiful roses reach you in just 48 hours after being harvested in Colombia?

Well, here's the scoop: these fresh flowers are kept at a chilly temperature. Get ready for an exciting peek into the magical world of flower imports!

Why do flowers drive so fast?

They put the petal to the metal.

Floral Preservation

When we cut flowers from plants, their freshness typically lasts for a short period, usually around 7-12 days. These solutions contain essential components like nutrients to nourish the flowers, biocides to fend off microbes, and pH regulators to ensure they remain vibrant and beautiful for much longer.

Sources: CalFlowers (www.cafgs.org), Society of American Florists (safnow.org)

Food Safety

Food safety is important because it prevents us from getting sick. If food is not handled or prepared properly, it can become contaminated with harmful germs or bacteria. New innovations will help make sure our food remains safe to eat as it goes from the farm to its final destination.

Activity

Traceability Time

With the help of technology, we now have a special log that tracks the journey of berries from the farm to your plate using something called a blockchain. Your job is to use the information from the log to answer the related questions.

Harvest
4/10/24 8:00am
Watsonville, CA
Field temp: 60°F

Transport to Cooler/Warehouse
4/10/24 10:15am
Watsonville, CA
Truck temp: 60°F

Loading
4/10/24 8:00pm
Watsonville, CA
Cooler temp: 36°F

Packing
4/10/24 6:30pm
Watsonville, CA
Cooler temp: 34°F

Pre-cooling
4/10/24 12:00pm
Watsonville, CA
Cooler temp: 33°F

Transport to Dist. Center
4/11/24 4:00am
Tracy, CA
Truck temp: 35°F

Distribution Center
4/11/24 8:20am
Tracy, CA
Warehouse temp: 34°F

Placed on Store Shelf
4/12/24 3:00pm
Sacramento, CA
Store temp: 34°-68°F

Transport to Store
4/12/24 6:20am
Sacramento, CA
Truck temp: 34°F

Questions:

1. How many hours passed from harvesting the berries in Watsonville to loading them onto the truck for Tracy?
2. How long did it take for the berries to go from packing in Watsonville to reaching the grocery store shelves in Sacramento?
3. What's the time gap between pre-cooling and packing the berries in Watsonville?
4. How many hours did it take for the berries to make their journey from the farm to the grocery store shelves?

Standards: CC ELA: RST.6-8.7; CC Math: 3.MD.A.1, 4.MD.A.2

Activity

Welcome to the Carnivore Cafe

Welcome to the Carnivore Cafe, where temperature meets taste! Knowing the right cooking temperatures is the key to a safe and tasty meal. The right temperature, determined by a food thermometer inserted in the thickest part of the meat, helps make sure that any harmful microorganisms in the meat are destroyed.

Check out the menu below with our delicious meats and their recommended internal temperatures. Use your formula-fueled brain to convert these temperatures into Celsius (Celsius = (Fahrenheit - 32) * 5/9) and unlock additional information on the menu. Bon appétit!

MENU

Meat Type	Recommended Internal Temp. (°F)	Recommended Internal Temp. (°C)
Chicken Leg	165°F	
Ground Beef Burger	160°F	
Pork Chop	145°F followed by 3 min. rest	
Grilled Fish	145°F	
Roast Turkey	165°F	

Sources: USDA Food Safety and Inspection Service (www.fsis.usda.gov/food-safety), US Food and Drug Administration (www.fda.gov/food)

Standards: CC Math: 5.MD.A.1, 6.RP.A.3.D, 6.NS.B.2; Health Education: Grade 3: 1.3.P, Grade 4:1.4.N,1.5.N, Grade 5: 1.5.N, Grade 7 and 8: 1.4.N

Did you know?

Some fresh produce, like strawberries, are "pre-cooled" before entering a refrigerated room or warehouse. The pre-cooling process often uses a forced-air cooling system where cold air is circulated around the berries to remove heat. This added step helps berries stay fresh longer.

What do you call a chef who works in a hazardous kitchen?
A recipe for disaster!

Scan and See!

Come along on a journey with Zach Barnes, a grower for Dole, as he shows viewers how blockchain technology helps us keep track of where our food comes from. In this two-minute video, Zach explains how blockchain is like a digital map, allowing us to follow the path of our food all the way from his farm to our tables.

What is Rapid Pathogen Detection?

This technology provides a way of quickly finding harmful germs like bacteria or viruses in our food. We now have faster ways to spot these germs early on and catch any issues before they can make their way into our food supply.

What is Blockchain Technology?

Details about our food, such as where it's grown, how it's processed, and where it's shipped, get stored in digital blocks. These blocks are like links in an unbreakable chain of information. This chain becomes vital when we need to quickly spot and fix any problems. We can check out this info by scanning QR codes on certain foods. It's like having a mini digital tour of our food's journey right at our fingertips!

What are Sensor Technologies?

Special sensors are placed in storage facilities and on shipping containers. These sensors measure temperature, humidity, and air quality. The data from these sensors is collected in real-time, helping us spot possible problems in the environment.

The House That Tech Built

Picture this: in 30 A.D., Roman Emperor Tiberius fell ill, and the prescription for his recovery was as simple as it was delicious—one cucumber a day! Enter the world's first greenhouse, a simple structure with stone walls and a glass ceiling, where cucumbers thrived in Rome's cold winters. Fast forward to today, where greenhouses have become complex growing environments, thanks to cutting-edge technology. Join us on a journey to explore how greenhouses have evolved, ensuring that many of the foods we love are available year-round!

SCAN & SEE

Step behind the scenes with us as we explore the incredible world of Gotham Greens, where glass, steel, and cutting-edge technology meet! In this video, you will see inside these massive greenhouses, showcasing how they use innovations to cultivate fresh produce, from vibrant leafy greens to flavorful herbs.

What's new with you?

Greenhouse technology combines nature and innovation:

Smart sensors monitor temperature, humidity, and light for optimal plant growth.

Carbon dioxide in the air is also monitored to maximize photosynthesis.

Water and fertilizer are recycled to conserve resources.

Planting robots prepare the soil and plant seeds or seedlings.

Harvesting robots identify, pick, and prepare ripe fruits and veggies.

Made in the Shade VS. Lovin' the Light

Plants have their own preferences when it comes to sunlight. Some plants, like tomatoes and cucumbers, can't get enough of the sun's warm and bright rays. While other plants, like ferns and orchids, prefer a little shade.

For shade loving plants, manual or automated shading systems can be used to limit the amount of sunlight reaching plants. For sun loving plants, artificial lighting can be installed so plants get the maximum amount of light, even on cloudy days.

Activity: Build -a- Greenhouse

Standards: NGSS: 3-5-ETS1-1

Let's build a greenhouse to learn more about how light affects plant growth. You'll need a small cardboard box, a potted seedling, string lights (optional) and household items like scissors, tape, cling wrap, or wax paper. Ready? Let's grow!

Come up with a plan, using the materials available, to limit or increase the plant's exposure to light. Build your greenhouse.
Place your plant inside and check it every day. Don't forget to water it periodically.
Make observations about the plant's growth and how it responds to light.
Tell friends or family what you discovered about plants and light!

Did you know?

Worldwide, there are more than a million acres of vegetables grown in greenhouses each year.

Sources: First Step Greenhouses (firststepgreenhouses.com), Ohio State University (u.osu.edu/greenhousegurus)

Activity: Sensor Says...

Sensors are able to measure different aspects of the greenhouse environment, like temperature, humidity, and light. These sensors talk to each other through the internet. By communicating with each other, the greenhouse can make decisions. If it's too hot, the system can cool things down. If a plant needs more light, it can turn on artificial lights. Pretend YOU are the greenhouse and decide if the readings from the greenhouse are too high, too low, or just right.

Circle your answers

Temp. 9:00pm 70°F	too low / too high / just right	
Humidity 65%	too low / too high / just right	
Light: 4500 foot candle	too low / too high / just right	
Temp. 7:30am 75°F	too low / too high / just right	

CROP STATS

Crop:	Poinsettias
Ideal Temp:	80°F (day), 65°F (night)
Humidity:	50-60%
Light:	5000 foot-candles

Standards: CC Math: 3.OA.D.9, 4.NBT.A.2

Barnyard Breakthrough

Picture a world where dairy cows produce allergen-free milk, chickens produce eggs that hatch exclusively female offspring, and pigs are resistant to respiratory disease. Whether it's the soft fleece of sheep or the sizzle of a burger on your grill, each species holds a distinct genetic tale. Discover how advancements in genetic science, including the revolutionary CRISPR-Cas9 technology, are paving the way for stronger, healthier, and more sustainable livestock production.

SCAN & SEE

Explore the world of animal genetics in this UC Davis Animal Science Department video. Discover the unique traits of livestock animals and how scientists are using genetic innovations to boost both animal and human health. It's a fascinating journey into the science behind improving our furry and feathered friends.

Cows that produce a lot of milk

Animals that are calm and friendly

Livestock that grow slowly

Animals that are poor mothers

Sheep that have undesirable wool colors

Chickens that don't get sick

Young that eat well and grow quickly

Pigs that are strong and healthy

Livestock that are often sick

Activity

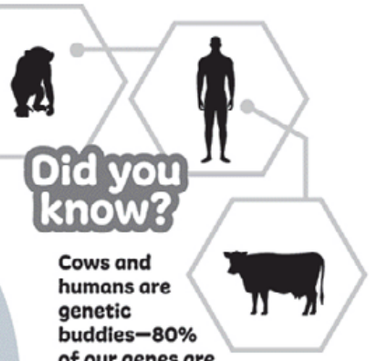
The Barnyard Best:

Selecting Desirable Traits in Livestock

In the natural world, animals inherit genetic characteristics from their parents, in the same way that humans do. Some of these inherited traits are desirable, contributing to the animal's well-being, while others may pose challenges. These traits are passed to the offspring through DNA, the genetic material that carries instructions for the development and functioning of living organisms.

Color the desirable (positive) traits green and the undesirable traits red. Discuss how the desirable traits will help animals survive, find mates, and produce offspring.

Standards: NGSS: MS-LS1-5, 3-LS4-2



Did you know?

Cows and humans are genetic buddies—80% of our genes are identical. That's nothing compared to our genetic likeness to chimpanzees, which share a whopping 96% of similarities.

What do you get when you cross an angry sheep with a cow?

An animal that's in a baaad moood.

The Big Breakthrough: CRISPR-Cas9

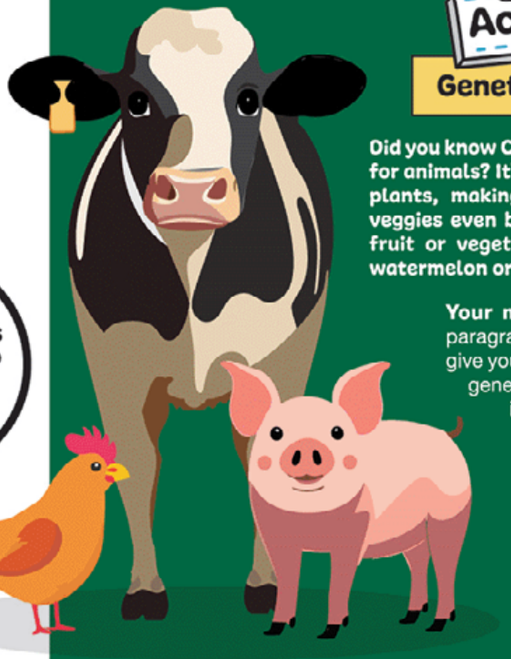
CRISPR-Cas9 (CRISPR) is one of the newest developing breakthroughs that is changing our world, including livestock production. Think of CRISPR as a special pair of scissors that can cut out undesirable traits and insert desirable traits. Using CRISPR, scientists can carefully change a tiny piece of the animal's instructions to make the animal resistant to certain diseases, improve animal growth, and reduce impacts on the environment.

The Minds Behind CRISPR-Cas9

Meet Jennifer Doudna, a biochemist, and Emmanuelle Charpentier, a microbiologist, the brilliant duo behind the invention of CRISPR-Cas9. These pioneering scientists have unlocked new possibilities in genetic research, offering hope for advancements in medicine, agriculture, and more. Recognized for their exceptional contribution, Jennifer and Emmanuelle were awarded the Nobel Prize in Chemistry in 2020.

Activity

Genetic Glow-Up



Did you know CRISPR technology isn't just for animals? It's also rocking the world of plants, making our favorite fruits and veggies even better! Imagine your go-to fruit or vegetable – maybe it's a juicy watermelon or a crunchy carrot.

Your mission: Write a persuasive paragraph to convince scientists to give your favorite fruit or vegetable a genetic upgrade. Pick a specific improvement, like making it tastier or more resistant to pests. Be sure to include at least three reasons why your plant should be improved. Get ready to make your favorite snack even tastier!

Standards: CC ELA: W.3-8.1

Sources: MIT Technology Review (www.technologyreview.com), UC Davis Animal Science (animalscience.ucdavis.edu), The Nobel Prize (www.nobelprize.org)

GLOSSARY

AI algorithms: Instructions or rules that artificial intelligence systems use to perform tasks or solve problems.

Artificial: Something created or designed by humans to imitate something in nature.

Atmosphere: The gases surrounding the earth or another planet.

Automated: A process or system that is able to control tasks without direct help from humans.

Bacteria: Tiny living organisms that can be found everywhere, including in soil, water, and on our bodies.

Carbon fiber: A strong and lightweight material made from thin strands of carbon atoms, commonly used in sports equipment, aerospace, and automotive parts.

Colony: A group of bees living and working together in a hive.

Contaminated: No longer pure because it has harmful or unwanted substances in it.

Debris: Scattered pieces of waste or remains from something that has been broken, damaged, or destroyed.

Ecosystem: A community of living organisms, like plants and animals, and their physical environment, such as air, water, and soil.

Efficient: Doing something well and quickly, without wasting time, energy, or resources.

Fertilizer: A substance added to soil or plants to help them grow better.

Foliage: The leaves of a plant.

Foot-candles: The brightness or illumination of light in a specific area. It is the amount of light produced by one candle at a one-foot distance.

Foreign material: Anything that is not supposed to be in a particular place or substance.

Genetic: Traits or characteristics that are passed from parents to their descendants through genes.

Global Positioning System (GPS): Technology that uses satellites to help determine the exact location of a person, machine, or object on Earth.

Humidity: The measure of the amount of moisture or water vapor in the air, showing how damp or dry the air feels.

Inherit: To receive traits, characteristics, or possessions from one's parents or ancestors.

Irrigation: The practice of providing water to crops or plants to help them grow.

Livestock: Animals that farmers raise to provide milk, eggs, meat, and fiber.

Machine learning: Technology that enables computers to learn and make decisions without being specifically programmed.

Maneuverable: Easy to move or control, especially when navigating through tight spaces.

Manual: Performing a task using your hands or physical effort, without relying on machines

Mates: Animals of the opposite sex coming together to form partnerships for the purpose of having babies.

Methane: A type of gas that we can't see or smell. It's found in the air and comes from decomposition. Too much methane can make the Earth warmer.

Microbes: Microscopic living organisms, including bacteria, viruses, and fungi.

Microorganisms: Microscopic living organisms, including bacteria, viruses, and fungi.

Nutrients: Essential substances that plants and humans need to grow and stay healthy.

Offspring: The young of a living organism, produced by their parents through reproduction.

Pesticides: Substances used to control or eliminate pests that can harm crops, animals, or humans.

pH: A measure that indicates how acidic or basic a substance is.

Pollinators: Animals or insects that carry pollen from one flower to another.

Preserved: Keeping something in its original state or condition for a long time.

Processing plants: Facilities where raw materials, such as crops or livestock, are transformed into various products through different processes.

Resistant: To stay strong and healthy, even when faced with challenges such as disease or drought.

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

Sustainable: Practices that meet the needs of the present without compromising the needs of the future.

Tanker truck: A big vehicle that moves liquids like milk from one place to another.

Teats: Part of a cow's udder from which milk is released during the milking process.

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

What's Growin' On?

Fields of Innovation

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- To find the answers to activities in this newspaper.
- To order additional free copies for your teaching team, classroom, or ag literacy event.
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Resources

Ag Explorer: Careers of the Future
agexplorer.ffa.org/career

Agronomy 4 Me
agronomy4me.org

Journey 2050
journey2050.com

National Ag in the Classroom Virtual Tours
agclassroom.org/student/virtual

National Institute of Food and Agriculture
nifa.usda.gov

Nutrients for Life
nutrientsforlife.org

Science of Agriculture
scienceofagriculture.org

The WG Center for Innovation and Technology
wginnovation.com

Picture Your Future: Adventures in Ag Tech

As we look into the future, envision a world where farmers, ranchers, engineers, scientists, and a multitude of tech professionals join forces to provide for our growing population. Now, armed with knowledge about ag innovations, reflect on your ideal career in agriculture.

Would you rather?
(circle your choice)

Work inside OR Work outside?

Travel OR Stay close to home?

Work on a team OR Work independently?

Work with animals OR Work with plants?

Plan something OR Build something?

Work with technology OR Work with tools?

Work with machines OR Work with people?

Activity: Ag Innovators of the Future!

Draw a picture of yourself working in agriculture. Imagine the innovative ways you can help produce food, fiber, or flowers while taking care of our planet. Include realistic details, like tools and technology, that will help you succeed in your future career!

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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