

19th Edition

What's Growin' On?

The Benefits of By-products



Find these hidden items:



football



sock



heart valve



pencil



bandage



nail polish



volleyball



cotton swab



paint



vitamins



oil



oyster shell



biodegradable bottle



For Extra! Extra! extension lessons, visit www.LearnAboutAg.org/resources/wgo or call 916-561-5625.

What Else Does the Agriculture Industry Provide?

In this edition of *What's Growin' On?* we will explore the production of agricultural commodities and the by-products that are produced as a result of making the intended **primary product**. **Commodities** are livestock, field crops, and orchard crops that are produced and harvested for an intended purpose. **By-products** are secondary products that are collected from the remaining materials not used in the production of an intended primary product. For example, a wheat farmer harvests the heads of wheat to sell the kernels as a product. The farmer can then go back to harvest the stock of the wheat to be baled and sold as straw for animal bedding, making the straw a by-product. This is just one example of how the agriculture industry is practicing **sustainability**, reducing waste, and maximizing the uses of each commodity.

You might be surprised at the by-products that come from agriculture products, but California farmers, ranchers, and agriculture employees have been working diligently for years to maximize the uses of each crop. They have done so by maximizing the use of technology to increase crop yields, continuing education to always learn how to use 100% of the crop, and creating innovative ideas to make the agriculture industry a continued leader in green practices.

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Read All About It!

For the past 19 years, California Foundation for Agriculture in the Classroom has produced *What's Growin' On?* to help students explore and learn the versatile ways the agriculture industry influences everyone's daily lives. This year's edition, *The Benefits of By-products*, is inspired by the diverse range of by-products that come from all sectors of the agriculture industry. The articles and activities featured in *What's Growin' On?* are designed to educate students about the commodities they use in their daily lives are used in both products and by-products.

Each annual edition of *What's Growin' On?* is developed by educators and reviewed by leading agriculture industry experts to provide relevant and accurate information. The activities on the following pages are aligned to third through eighth grade California State Standards including Common Core and Next Generation Science Standards.

Free Copies for California Teachers!

Place *What's Growin' On?* in the hands of your students by ordering a free classroom set. Order online at LearnAboutAg.org/resources/wgo.

Answers available online!
Visit LearnAboutAg.org/resources/wgo

California's FRUIT AND VEGETABLE ALL★STAR HEAVY HITTERS

What's the Use?

Fruits and vegetables are produced so we can enjoy their nutritious and delicious taste. What do we do with the “leftovers” that we don’t consume? Research the following commodities using online resources to fill in the chart below. The first one is completed for you! **Standards: CC ELA: RI.3.5; W.3-4.7**

Commodities	By-Products	Use for Final Product
Tomato	Peels and Seeds	Animal Feed
Apple		
Avocado		
Onions		
Carrots		

Did you Know?

California produces about 95% of the U.S.A. tomatoes for canning, making California the number one tomato producer in the world! To learn more about tomatoes, visit tomatowellness.com



Did you Know?

It takes roughly ten whole carrots to make eight ounces of juice. After carrots are pressed for juice, the pomace is collected and used as livestock feed. To learn more about fresh carrots, visit LearnAboutAg.org/resources/fact



Did you Know?

Avocado pits can be used to dye fabrics. Use the QR code to read the *New York Times* article on one artist making a profit by putting by-products to use!



Did you Know?

At Gill's Onion processing facility, they can process up to a million pounds of onions a day, creating 150 tons of onion waste per day. Gill's is turning the collected onion waste into a useful by-product by transforming it into a form of electricity! To learn more, visit LearnAboutAg.org/programs/conference_sessions/ and participate in a recorded tour of their Oxnard, CA facility.



The World's Easiest Tomato Sauce

Tomato sauce can be used in a variety of recipes! This simple sauce recipe created by Patrick Mulvaney, owner and chef of Mulvaney's B&L in Sacramento, California, will have your taste buds dancing in excitement.

Directions

1. Chop your garlic, onion, and oregano and place it into a blender with a small portion of olive oil.
2. Blend until it becomes an even texture. Pour half the mixture into a preheated saucepan and cook down until lightly brown.
3. With the other half of the mixture, add canned tomatoes and blend again to desired texture.
4. Add the mixture from the blender to the rest of the mixture in the saucepan and cook down to desired consistency.
5. Pour over your favorite pasta and enjoy!

Ingredients

3 cloves of garlic
1 small onion peeled and cut in quarters
One tablespoon of dried oregano
32 ounces of canned tomatoes
Olive Oil
Salt and Pepper



What's Inside an Apple

Like many other fruits and vegetables, apples have an additional market that can be generated from all portions of the fruit. After apples are picked for the intended use, there are parts of the apple that can be used alternatively to increase the dollar value and use of the entire commodity, known as by-products. Use the word bank below to identify the parts of the apple by learning the by-products that come from each part of the apple! **Standard: CC ELA: RI.3.1**

The peel packs a mean punch of **antioxidants**, making it a great health supplement. The peel becomes a by-product which can be dried and used in health supplements.

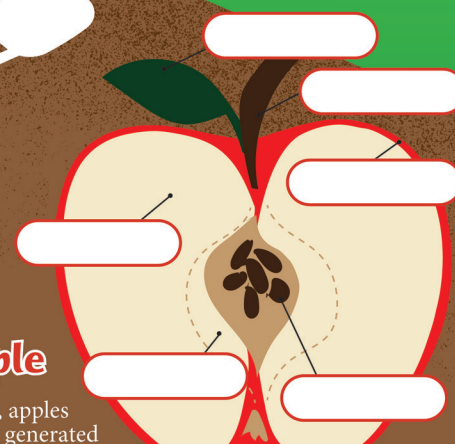
The flesh is a rich source of antioxidants and dietary fiber. The flesh is mainly used for animal feed but can also be used for its gelling properties in cooking.

The core is rich in antioxidants and can be ground and combined with the rest of the apple's flesh to be used for animal feed.

The seeds are used as a feed additive with the core and flesh, or used in fragrances.

The stem is a by-product that is typically ground and used as plant nutrients such as compost.

The leaves absorb light energy from the sun for **photosynthesis** making them filled with plant nutrients that can be reused to fuel other plants.



The Scoop on Drupes

A drupe is a fleshy fruit with a thin skin containing a central stone known as the pit or endocarp. Drupes can also be nuts that have a shell around the endocarp, with an outer covering that is thick, leathery, and grey-green in color, called the hull. The most commonly consumed drupes are almonds, walnuts, pistachios, olives, and peaches. Many people enjoy eating drupes, typically as fresh fruit or nuts. The by-products of drupes are used to make household products, cosmetic items such as lotion and body wash, sandpaper, soil additives, and even types of biomass fuel!

Did you Know?

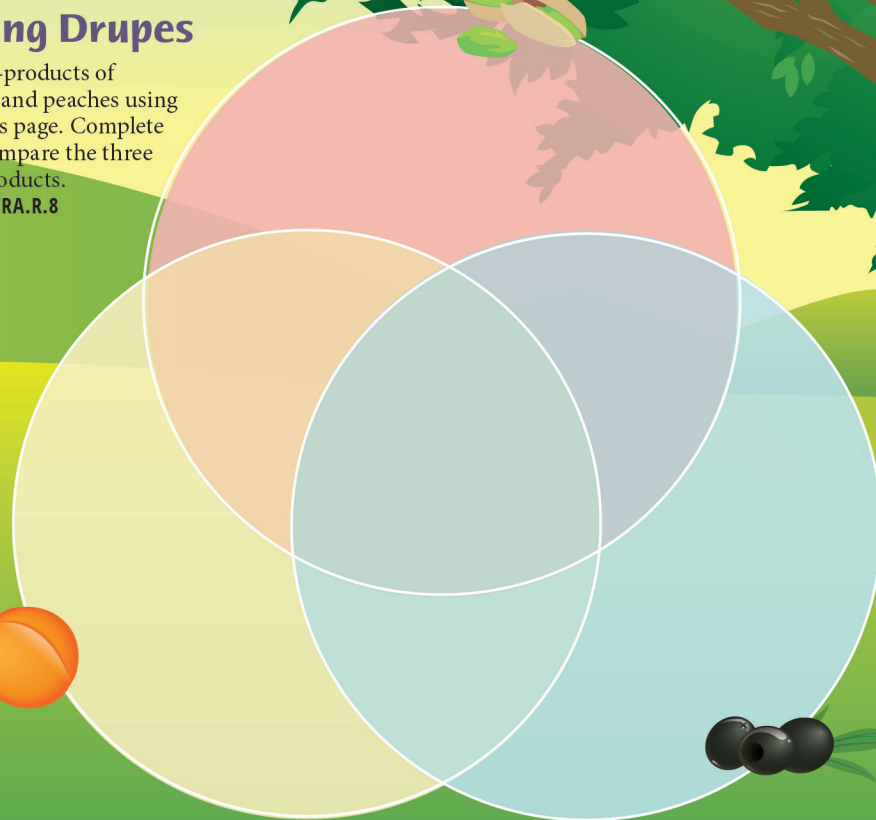
During World War I, peach pits were gathered, ground, and used as filters in gas masks.

Activity

Discovering Drupes

Investigate the by-products of pistachios, olives, and peaches using the sources on this page. Complete the diagram to compare the three commodity by-products.

Standard: CC ELA: CCRA.R.8



Almond Anatomy

The California almond industry is making strides to become a zero-waste industry by 2025 to ensure all parts of the trees are being put to maximum use. Almond trees produce fruit for an average of 25 years. After that, the trees are either ground up, chipped and reincorporated into the soil (called Whole Orchard Recycling) to help improve soil health, or removed from the orchards and converted into biomass fuel. The hull of the almond can be used as livestock feed and the almond shell can be used for livestock bedding. Using the word bank on this page, identify the parts of the almond provided.

Standards: CC ELA: RI.3.7; RF.3.4.C

Word Bank:

Stem
Hull
Shell



Did you Know?

Almond hulls can be used in manufacturing diapers! Hulls are super absorbent, sopping up 10 times their weight in water. They are also being researched as feed for poultry.

Drupe DIY Body Scrub

Walnut shells have been used as an exfoliating agent in body scrubs for many years. Research and find body scrub recipes and then develop your own recipe! Create a short digital presentation of your recipe to share with your classmates.

Standards: CC ELA: SL.3.4, RI.3-5.1, W.3-5.6



May the Forest Be with You

California is one of the largest agricultural producing states in the nation with forests covering more than one-third, 33 million acres, of the state with a bountiful **renewable resource**. Many of the trees harvested in California are used for **timber**, which is wood that is suitable for structural uses like your home and school. More than 5,000 products and by-products can be made from timber, even using the waste wood and sawdust from processing to be made into various items such as:

- **Waste Wood** and sawdust are used to make particle board, pet bedding, and pellets for home heating.
- **Cellulose gum** that can be found in chewing gum and toothpaste.
- **Woodchips** that you find in the landscape design at your school.
- **Rayon string** used to make disinfectant wipes and bath towels.

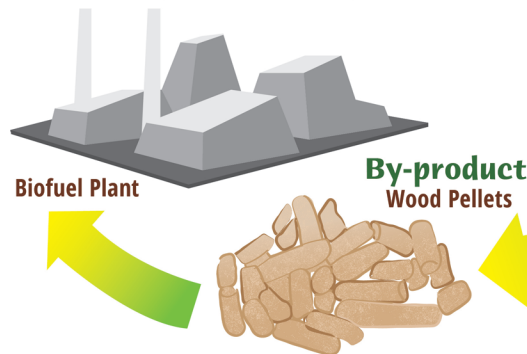


Did you Know?

Some nail polishes contain a wood component called **nitrocellulose** that makes the polish dry quickly!

Forest Powered

Wood has been a fuel source for many centuries from the Bronze Age of fueling the engines of trains to now warming homes of Americans through wood pellet stoves. Wood pellets can be produced from the collection of offcuts that are made into one consistent texture to burn evenly. Research the use of wood as fuel sources. On a separate sheet of paper, create a timeline of the uses of timber. Cite your sources. **Standard: CA History-Social Science: HSS Analysis Skill K-5, HSS Analysis Skill 6-8**



Cutting Concepts

Using a cross-section of a tree stem discover how a tree grows by identifying the function of all layers of the stem including layers of bark, layers of wood, and cambium (phloem and xylem) by using Arbor Day Foundation's website.

www.arborday.org

Standards: NGSS: MS-LS1-1, CC ELA: RI.3.5

Timber!

Timber can be used to manufacture various different products and by-products. Using this link northamericanforestfoundation.org/consumers, identify and list items not mentioned on this page that come from timber. **Standard: CC ELA.RI.5.7**

For example: Clothing, tires, and even football helmets!

Activity

Collect leaf samples that vary in shapes and sizes from different trees in your neighborhood. Scan the QR code and follow the directions to create leaf rubbings. **CA Visual Arts: 3.VA:Cr1.2**



Cereal-ously Great By-Products Come from Cereal Crops

What did you have for breakfast today? If you had a bowl of cereal, toast, or pancakes, you ate a type of **cereal crop**! Cereal crops, also known as grain crops, are primarily grown for their small edible seed that can be turned into a wide variety of **consumable** and **inconsumable** by-products. Rice and wheat are two common cereal crops that we will crack open on this page. Can you think of three other types of cereal crops that you consume regularly?

Did you Know?

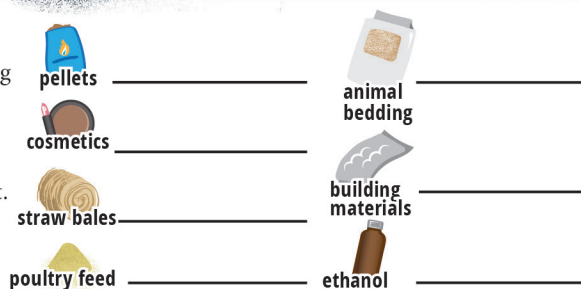
Most rice fields in California are seeded by airplane and mature four to five months later.



Match Me!

To make the following items, rice and wheat by-products are used. Using the sources included on this page, research and write next to each picture whether you think it is a by-product of rice or wheat. Have an adult check your answers online to see if you're correct!

Standard: CC ELA: RI.5.7



Wholesome Wheat!

Thin Crust Pizza Dough

Servings: 2

Ingredients:

1 package active dry yeast 2 tablespoons of canola oil
1 cup warm water 1 ¼ cups of whole wheat flour
1 teaspoon of sugar 1 ¼ cups of all-purpose flour
1 teaspoon of salt Cornmeal, for dusting

Directions:

Preheat oven to 425°F. In a large mixing bowl, dissolve yeast in warm water. Stir in remaining ingredients and combine until dough forms into a ball. Let rest for about five minutes. Divide dough in half to make two crusts. Grease two baking sheets or pizza pans with nonstick spray and dust with flour. Sprinkle with cornmeal. Flatten each ball of dough one at a time on a baking sheet and prepare the pizza with seasonal commodities. Bake 15-20 minutes. Let cool and enjoy!

Recipe Source: eatwheat.org/recipes/thin-crust-pizza-dough



Serving Up the Right Size!

This recipe is for two pizza crusts. What if you wanted to make pizza crust for your entire class? Determine the numbers of crusts needed and rewrite the recipe below.

servings:	packages of dry yeast:	warm water:
sugar:	salt:	canola oil:
whole wheat flour:	all-purpose flour:	cornmeal:

Standards: CC Math: 3.MD.A.2, 5.NF.B.6

6 After the heads are harvested, rice straw can be harvested for use as livestock bedding.

2 The facilities clean and sort paddy rice, also known as rough rice with the hulls still attached, at a quick rate. Once the rice is cleaned and dried, the milling process begins.

3 Risk husks, a rice by-product, can be used for livestock bedding. Secondheads, another by-product from milling, are used to make cereal and rice flour.

5 Rice bran, a rice by-product, is sold as animal feed or for medicinal purposes.

4 This step takes brown rice and transforms it into white rice known as polishing.

Do you want to learn how to turn brown rice to milled white rice? Check out LearnAboutAg.org/resources/bites to complete the activity!

Becoming an Expert!

Now that you have taken a journey through the rice mill, become an expert on the journey that wheat takes from planting to post harvest. Research and create a graphic flowchart, like the rice flowchart above, to display the products and by-products that are available from wheat.

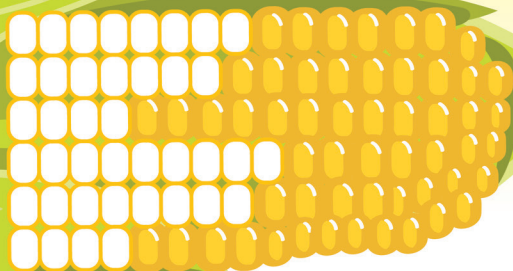
Standards: CA Arts: 7.VA.Cr.2.3; CC ELA: RI.4.7

A-maize-ing Non-California Commodities

Corn, soybeans, and peanuts are commonly consumed crops, but are not commonly grown in California. Luckily, enough states produce these crops for Californians, and others around the world, to enjoy year-round. Let's dive into the three crops, whose by-products are in other products we use every day!



ISNOILIL
AIANIDN
WIOA
IMTANENSO
ANAKESBR
HOOI



Corn Belt

There is a section of states known for producing large amounts of corn. These states are known as the Corn Belt. Corn is made into a variety of by-products, with a large portion going to food products, biofuel production, alternative plastic products, animal feed, and even more! Unscramble the letters above to identify the six Corn Belt states that produce the corn by-products you enjoy! **Standards: CC ELA: L.4.2.D; L3.3**



Surprising Soybeans

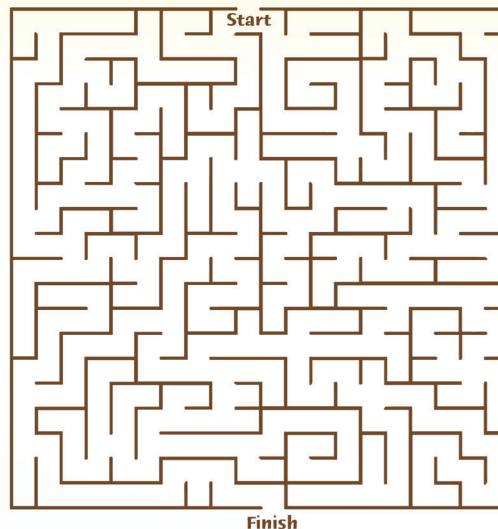
Ford Motor Company has been using soybeans in an alternative way to create **biodegradable** products for their cars since the 1940s. These "green" products are used as both interior and exterior vehicle parts. Use the QR code to watch how soybeans can be used to replace **non-renewable resources**.

Standard: CC ELA: W:3.2

Full of Beans

Read how soybeans play a role in great storytelling. Pick up the book, *Full of Beans*, and discuss the central role soybeans plays in Henry Ford's successes. **Standards: CC ELA: RL.3.1, RL.4.2**

Find the way through the "maize"!



Nobel Prize Winner Spotlight

Barbara McClintock, 1902-1992, was known for her work with **mobile genetics** in corn. Using the Nobel Prize website, nobelprize.org, research and write a summary paragraph about Barbara's life and impact on the agricultural science community.

Standard: CC ELA: W:3.2



Did you Know?

Dr. George Washington Carver was responsible for developing over 300 peanut products and by-products.

Thinking like Henry Ford!

Henry Ford, the founder of Ford Motor Company, was known for his creative thinking in using agricultural products like soybeans, as well as other agricultural by-products, to create the soybean plastic car in 1934. In the following years, Henry inspired scientists at Ford Motor Company to continue to explore the creation of more car parts out of agricultural by-products.

Try making your own bioplastic by following these instructions.

Ingredients:

- 1 tablespoon (14 g) cornstarch
- 2 drops corn oil
- 1 tablespoon (15 mL) water
- 2 drops food coloring



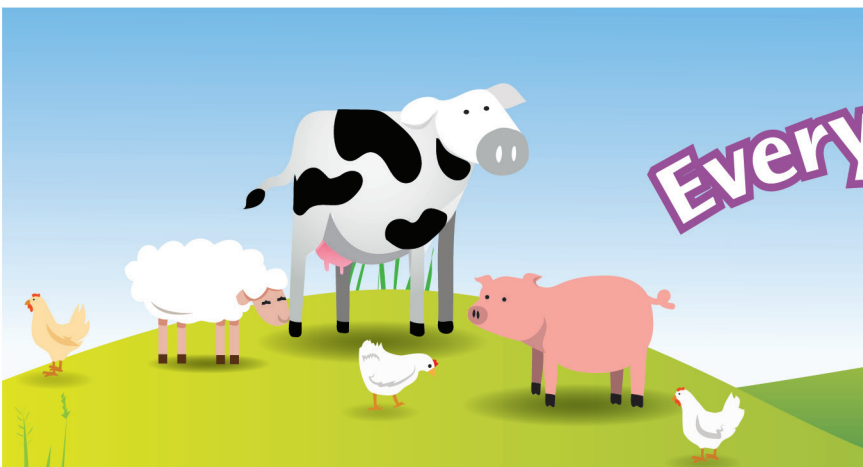
Instructions: Combine the ingredients in a sandwich-sized resealable plastic bag. Seal the bag and mix the ingredients by rubbing the outside of the bag until the ingredients are combined. Open the bag slightly to create a vent and place it into a microwave oven on high for 20-25 seconds. Carefully remove the bag from the microwave, and let it cool for a few minutes. Congratulations, you have made bioplastic like Henry Ford! **Standard: NGSS: 5-ESS3-1**

Powerful Peanut Plant

When you reach for peanuts, you are grabbing the fruit of the plant, also known as a **legume**. Other parts of the plant are by-products that include the peanut meal, the hull, the skin, and the peanut vines. Other than food items, these peanut by-products can be found in dyes for clothing, cosmetic oils, medicines, biofuel, and plastics. Work with a partner to identify items in your classroom that potentially have peanut by-products in them. Create a list and share with your classmates. **Standards: CC ELA: RL.3.1, RL.4.2**



Everything but the Oink, the Moo, and the Cock-a-doodle-doo!



The livestock industry raises a variety of animals including cattle, sheep, pigs, goats, poultry, and many other species for meat and alternative purposes. After the primary product is harvested, the remaining portions of the animals get put to further use by making thousands of livestock by-products. Some common products that you may recognize are furniture, clothing, medicine, plastic water bottles, and even glue! When in the grocery store, school, and your home, these various livestock products can be found throughout your daily lives.

Connect with Us

Did you know you can make your own artificial hide at home? Complete the activity to the right and share your results with us! Snap a photo and have an adult post it to social media. #LearnAboutAg

Did you know?

One cow hide can make:

12 basketballs,
144 baseballs,
20 footballs,
18 volleyballs,
18 soccer balls, or
12 baseball gloves.



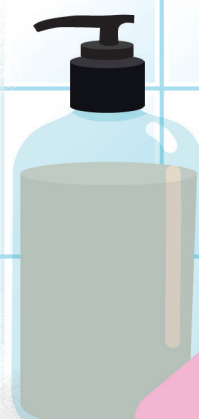
Did you know?

The number one by-product of the poultry industry is feathers! They can be made into plastics, used for biomass fuels, fertilizers, feed sources, or placed inside a pillow.



Did you know?

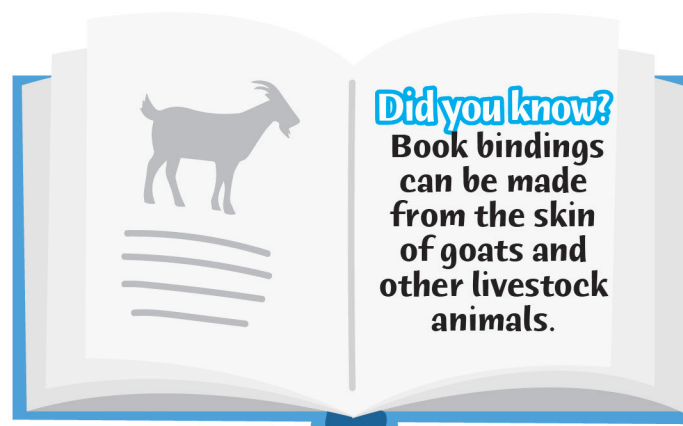
Lanolin is a by-product of sheep and goats and is used to make soaps and lotions.



Making Artificial Hide at Home!

1. Using scissors, cut the side of a paper bag out to create a square.
2. Take your square and crumble the bag in your hands, making it look as rough as possible.
3. Rip the edges of your square to make it an uneven texture to replicate the shape of a real hide.
4. To personalize your artificial hide, write a story using only illustrations.

Standards: CA Visual Arts: 3:VACr2.3, 7:VA:Cr2.3



Did you know?

Book bindings can be made from the skin of goats and other livestock animals.

On and Off the Hoof/Foot

Directions: Livestock animals that are raised for meat consumption also contribute to the production of a plethora of products. Shampoo can come from cattle, tennis racquet strings from sheep, bone china from pigs, candles from goats, and pillow stuffing from poultry, and so many more by-products after the meat is harvested! Calculate the percentage of meat and the percentage of by-products that each livestock animal provides based on the information provided. Round to a whole number. **Standard: CC. Math: 6.RP.A.3.C**

BEEF CATTLE:

Average weight is 1,000 pounds.
Meat provided is 430 pounds.

_____ % Meat provided

_____ % By-products provided

SHEEP:

Average weight is 135 pounds.
Meat provided is 62 pounds.

_____ % Meat provided

_____ % By-products provided

SWINE:

Average weight is 282 pounds.
Lean meat provided is 116 pounds.

_____ % Meat provided

_____ % By-products provided

GOATS:

Average weight is 65 pounds.
Meat provided is 35 pounds.

_____ % Meat provided

_____ % By-products provided

TURKEYS:

Average weight is 33 pounds.
Meat provided is 26 pounds.

_____ % Meat provided

_____ % By-products provided

CHICKENS:

Average weight is 6 pounds.
Meat provided is 4 pounds.

_____ % Meat provided

_____ % By-products provided

Did you know?

Per capita egg consumption nationwide is estimated to be 287.1 eggs per person, per year! To learn more about eggs check out LearnAboutAg.org/resources/fact



Did you know?

Eggshells can be used in the garden as a slug deterrent or compost additive.



This Little Pig Went to Market

Pigs are some of the most versatile animals in the livestock industry with the ability to use the whole animal for many by-products. Brainstorm with a partner the importance of creating by-products and analyze the items produced to the by-product category it comes from. Use the QR code to learn more about pigs and where their by-products come from. **Standards: CC ELA: SL.5.1, RF.3-5.4**



By-Product	Item Produced
Hair	Wood Adhesive
Brain	Medicine
Hide	Glue
Fatty Acids	Luggage
Blood	Artist brushes
Organs	Fabric Softener
Bones	Heart Valve replacements



Udderly Efficient Cattle By-Products!



Since 1993, California has been the nation's leading dairy state in milk production, with the most recent recorded amount of 39.8 billion pounds of milk produced in 2017. That is over 4 million gallons of milk! In addition to milk, dairy cattle farmers can also profit from marketing a by-product produced from dairy cattle: **manure**. With innovative technology, dairy farmers can reuse this somewhat smelly by-product - creating less waste and generating renewable energy.



From Cow to Curd - How Whey is Made

When making cheese, the first thing needed is milk. Milk is collected from cows and sent to a milk processing facility. The milk is then **pasteurized**, and the cheesemaker adds enzymes to create cheese flavor and texture. When making cheese, a liquid by-product is produced that is high in protein, called whey. Whey is considered a by-product from the cheese making process and is sold as a protein supplement. Try making Mozzarella cheese and collect the whey with your class by completing the Say Cheese Ag-Bite activity found at LearnAboutAg.org/resources/bites

No Oxygen Required - Making Biogas from Food Scraps!

Renewable energy can be created from manure, but did you know that it can also be created from food scraps? Scan the QR code to follow along in an experiment creating your own **biogas**. Cattle produce thousands of pounds of manure a year that can be transformed into by-products such as **biofuel**, soil amendments, **fertilizers**, and even building materials. Biofuel can be collected through the anaerobic digestion process. In the dairy industry, the anaerobic digestion process is the use of microbes to break down organic matter when oxygen is not present, generating biogas as the organic matter is decomposing. This biogas is collected and used as a renewable energy resource. **Standard: NGSS: 3-5.ETS1.1**



Did you know?
California is the top producer of butter and ice cream and number two for yogurt and cheese in the United States.

Buttered up By-Products!

To make butter at home, the first dairy product needed is heavy whipping cream. Heavy whipping cream is placed into a sealable container, filling only half of the available space. The cream is shaken vigorously, creating energy to repel the fat globules, causing the liquid to separate from the solid in the container. The solid piece is the butter, and the liquid is a by-product called buttermilk. Try making butter with your class!



Dairy Division

1. If an average cow produces 22,916 pounds of milk in one year, how much is she producing daily?
2. Considering these averages, how many cows will it take to produce 100,000 pounds?
3. If a gallon of milk weighs 8.6 pounds; how much does a quart weigh? Hint: There are 4 quarts in 1 gallon!
4. A milk tanker can transport 12,000 gallons in one trip; how many pounds of milk are in 1 tank?

Standards: CC Math: 4.O.A.A.2, 4 MD.A.1, 6 NS.B.2, 5 MD.A.1

History of Milk

Use this QR code to learn more about the historical findings of milk and milk by-products.



Warm and Fuzzy By-products

What do sweaters, shirts, socks, blankets, carpets, baseballs, cotton balls, and building insulation have in common? They are all made from natural **fiber**, from both plants and animals, sources that generate by-products. Plant-based natural fibers are sourced from three main agricultural commodities: cotton plants, **flax** plants, and trees (wood pulp). Fiber that comes from animals like sheep, goats, llamas, and alpacas is **wool**.



Did you Know?

The United States silk industry was booming from the mid-1800s till 1940s when rayon was introduced as a cheaper product, causing a decreased demand for silk. The general disruption caused by World War II put a halt on importing silk and while demanding that all silk produced in the U.S. be used in parachute manufacturing for the military.



Silkworm larvae

Famous Fibers

Activity

Directions: Using the information provided below, place the historical fiber events in the correct sequential order starting with the earliest event as number one and the most recent event as eight. **Standards:** CC ELA: RF.3-5; RI.3.3

- Eli Whitney invented the cotton gin in 1793 that mechanically separated the seed from the lint fibers.
- Between 3000 and 1000 B.C. the Persians, Greeks, and Romans were documented distributing wool throughout Europe.
- By 1665, about 100,000 sheep had been smuggled into North America to start the wool industry, despite England's efforts to stop it.
- The oldest cotton fibers and leftover fragments from processing were discovered in Mexico, dating back to around 5000 B.C.
- Flax fiber clothing was found in burial chambers in the Fertile Crescent dating back to about 3000 B.C.
- In the late 18th century, the flax processing industry was developed to keep up with demand for fiber.
- In 1925, the Federal Trade Commission named rayon as an official man-made fiber.
- In the 1885, Count Hilaire de Chardonnet patented the first successful cellulose product called rayon, or imitation silk.

Tech Check

Can't get enough of cotton? Check out this educational video to learn more about cotton fiber strength!



Fantastic Fibers

Using the information on this page, fill in an example of a product that you use on a daily basis that is created from each fantastic fiber.

Standard: CC ELA: W:3-5.2

Wool has been used for centuries to provide clothing, but it can also be used to produce items such as tennis balls, paint binder, and even lanolin that is used in lotions.

Common flax (or linseed) is grown for linen fabric. The harvested flax is used to manufacture linen sheets, clothing, and paper. The seeds are collected and crushed for flaxseed oil and flaxseed meal, products typically used in cooking.

Cotton fiber is separated in the ginning process to get the main product, cotton lint, with the resulting seeds and linters being collected as by-products. The cotton seeds are sold as livestock feed or pressed for cooking oil. The cotton linters can be turned into medical supplies like x-ray film and cotton balls.

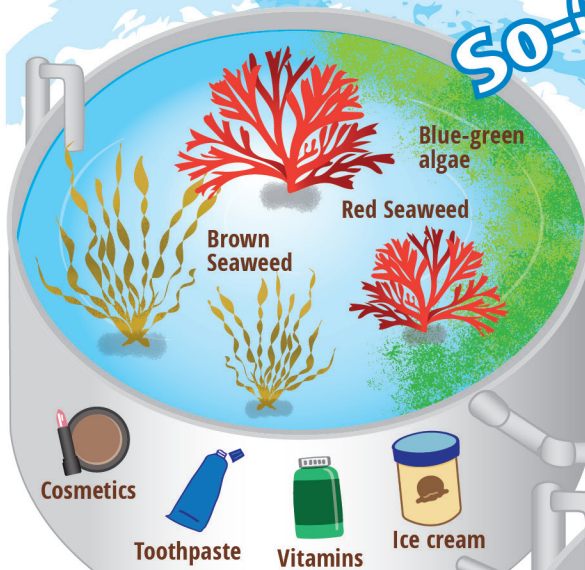
Wood pulp is a by-product of the timber industry that is used to make a synthetic (man-made) material. The cellulose of wood pulp is used to create thread known as rayon.

Imagine this...

Check out Hailee Luiz's 2020 story *The Wonderful World of Wool*, then write your own story about a fiber source. Write a story for the *Imagine this...* Story Writing Contest. Visit LearnAboutAg.org/programs/contest/ for details.

So-fish'-ticated Agriculture

Aquaculture is the raising of **aquatic animals** or the **cultivation** of aquatic plants for the purpose of human consumption and the repopulation of wild fish species. A variety of aquatic plants, shellfish (crustaceans), and finfish (fish with fins), including bass, catfish, tilapia, trout, sturgeon, and many more, are raised in aquaculture farms! With the rearing of these aquatic plants and animals, a variety of by-products are also produced. Explore the tanks below to learn about three categories of aquaculture by-products!



Aquatic Plants

There are many plants grown by the aquaculture industry, but seaweed and algae are the leaders. Seaweed is a main product that is included in different cuisines. Its extracts, such as carrageenan, alginate, and agar, are used in other products. Agar is used in food as a gel; alginate is used in the medical industry for healing wounds. Algae, like **spirulina**, is used for a variety of medicinal purposes, specifically in vitamins, as well as in fertilizers, water filtration systems, and cosmetics.

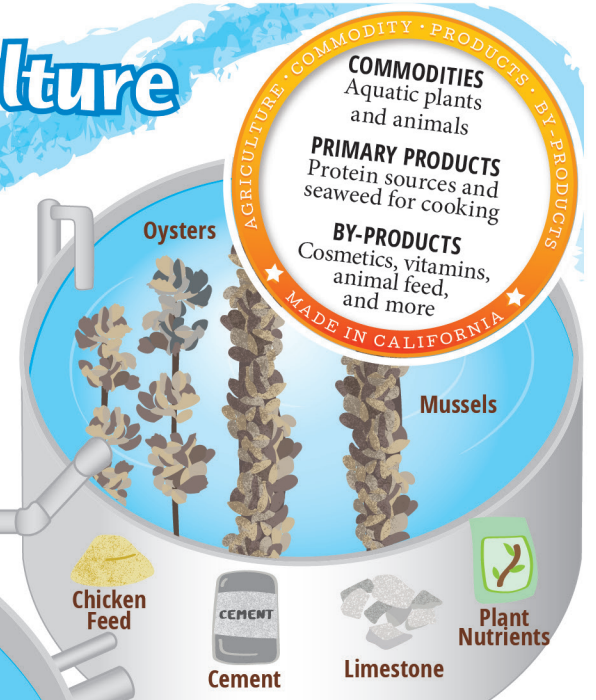
Activity Gyotaku Fish Art

Gyotaku, a type of art, means hand-rubbed finfish impression. It consists of applying a thin layer of ink on the surface of the finfish and then placing it on a piece of material to make a record of the size and species caught. Research your favorite finfish species and create your own creative background for Gyotaku fish art.



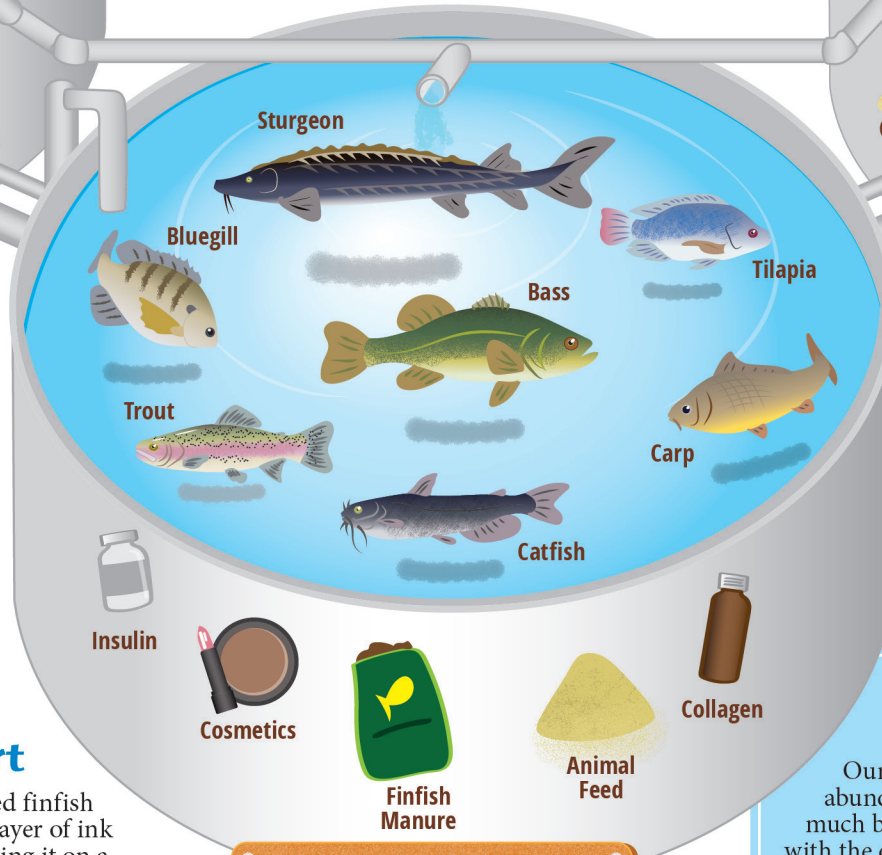
Shuckin' Shells

After the oyster meat is removed, the oyster shell, along with many other seashells, can be used in by-products. For example, they can be ground up and used as soil additives. Shells are mostly made up of calcium carbonate (CaCO_3), which is commonly added to soil to increase overall soil pH and plant health. With your classmates, research and design a soil experiment with three different oyster shell ratios for a bountiful crop. **Standard: NGSS: 3-5-ETS1-2**



Shellfish

Mussels, oysters, clams, and abalone are the common shellfish that are raised along the California coast as food. Oysters have been leading the aquaculture industry in California since the 1850s. After **shucking** the oysters there are many by-products that can be produced from the shells.



Finfish

Aquaculture finfish are raised for food, sports, bait, and lastly, eggs. Most of these finfish are raised as protein sources, but there are still by-products that come from finfish! From plant nutrients to household products, the aquaculture industry has a lot to offer!

Why aquaculture is necessary

Our oceans have the ability to produce an abundance of seafood, but we can only harvest so much before altering the natural supply. To keep up with the demand for seafood, aquaculture farms have been able to help meet the demand and repopulate fish species that are able to be raised on aquaculture farms. In 2018, California accounted for 37% of the aquaculture farms in the United States, making it the 5th top producer of aquaculture.

Now that you have seen what the aquaculture industry provides outside of a protein source, what other by-products can you add to these three tanks? Use the sources included on the page to start your research and list them in the space provided!

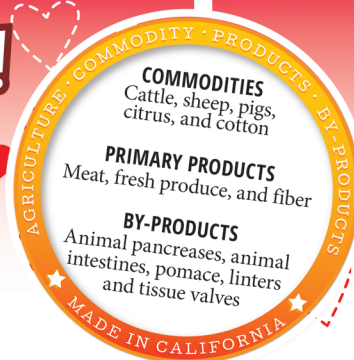
Standard: CC ELA: RI.4.7

Heart-full Thanks to Agriculture!

Match Me

Using the information provided on this page, draw lines from each feature to the part of the body it benefits.
Standard: CC ELA: RI.3.5

Both animals and plants **generate** products that are commonly found in your doctor's office, neighborhood pharmacies, or local hospitals. Vitamins, heart valves, and even bandages, are all made with by-products from plants and animals providing solutions and medical supplies for our health challenges. Cattle, sheep, swine, citrus, pomegranates, and cotton are just a few of the agricultural products that helps keep our bodies healthy and strong.



Did you Know?

Oranges are grown for the production of fresh fruit and juice. After the juice is collected, the peel and pulp of the orange still have a lot to offer the medical industry. The peel contains the essential oils that can be recovered and used to flavor vitamins and medicine. The pulp of the orange can be repurposed to become a fiber supplement.



The Powerful Pancreas

In the United States, 34.2 million people currently have diabetes. Insulin can be used to help people with diabetes. Insulin can be sourced from the **pancreases** of cattle and pigs, or artificially made. Pancreases of cattle and pigs are by-products of harvesting the meat from these animals.

It takes the pancreases from 26 cattle to provide one person enough insulin for an entire year. Calculate how many cattle it would take to supply enough insulin for one year for your entire family? Or your entire class? Determine the number of cattle and fill in the blanks below.

Standards: CC Math: 3.OA.A.3, 4.NBT.B.4

_____ Your family members x 26 cattle
per year = _____
pancreases
needed

_____ Your entire class x 26 cattle
per year = _____
pancreases
needed

Surplus Sheep

Sheep can offer hides and wool for ointments, but the intestines of sheep, and other animals, can also be used to make surgical sutures! Surgical sutures are sterile threads used to close wounds.



Heroic Hearts

Swine can help humans extend their lives by providing tissue valves to replace a human's heart valve that is not working properly. The animal valve can last anywhere from 10 to 20 years! Visit the American Heart Association's website www.heart.org to learn about the other forms of heart valve replacements.



Victorious Vitamins

Vitamins and minerals are key components in keeping our bodies functioning at maximum capacity. Many vitamins and minerals can be found in foods, and they can also be found in vitamin capsules or gummies made from the pomace of fruit such as pomegranates or oranges.

Take a poll asking your classmates who thinks taking supplemental vitamins and minerals is important. Create a bar graph illustrating your results. Standard: CC Math: 3.MD.B.3



Baffling Bandages

When you scrape your knee, you most likely reach for a bandage to protect the wound. The concept of the bandage was created in 1920, by placing a piece of **adhesive** with a small piece of cotton on the inside. Adhesives were traditionally made from animal by-products. Use online resources to identify alternative methods that were used prior to the development of the adhesive bandage. Bonus: What commodities and by-products were used?
Standard: CC ELA: RI.5.7



Clavicles and Cotton

Did you know that the most common broken bone in humans is the collarbone (also known as the clavicle)? To ensure proper diagnosis, doctors will take an x-ray of the injury. We have the cotton industry to thank for x-ray film that is made from cotton linters. Linters are the fuzz that is left after the ginning process, which can be used to make x-ray film and paper!



Making its Mark!

Choose an agricultural item that comes from a commodity and give three reasons why it should continue to be produced. Share with a partner for practice and then present to your class.

Standard: CC ELA: SL.3-8.4



FIRST AID

Classroom Check!

Using the word search, identify 11 different items highlighted in the newspaper that come from the agriculture industry.

Word Bank:

Wool Sweater
Football
Pet Food
Crayons
Chair
Applesauce
Bandage
Bread
Rice Hulls
Whey
Aquatic Plants

L L O O E T P I O S A L G E
R D W O O L S W E A T E R A
R A F O L F L E A S W S B Q
D E A P P L E S A U C E C U
O R A S L L U H E C I R A A
O B E E C A B A N D A G E T
F I L A F F R A A U L D Y I
T B T E A O E S L C S E T C
E O E A S O E Q S Y H R A P
P F F D E T D L E W N D N L
H A S E S B U C H A I R S A
P S N O Y A R C E H H S A N
H S E F A L A C T E W R N T
D T B D Q L A R E R A D G S

Did you Know?

Footballs used to be called "pigskins," but don't let the name fool you! 20 footballs can be made from one cowhide!

Beneficial By-products

After learning about all of the ways agriculture industry influences your life, identify one commodity. List all benefits it provides to your life in the space provided. Standard: CC ELA: CCRA.R.2

Benefits

Did you Know?

One tree makes approximately 170,000 pencils.

Did you Know?

If you play the violin, the bows are made with hair from a horse's tail!

Did you Know?

A single bale of cotton can make 325 pairs of jeans.

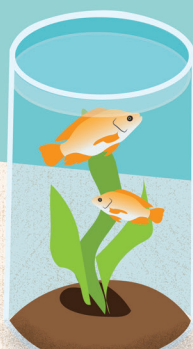
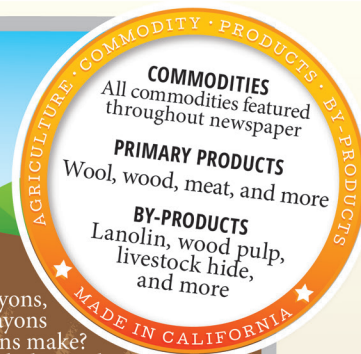
Farm to Classroom

Products and by-products found on a farm can be found all around you, from inside and outside your home, throughout the grocery store, and even in your classroom! Take a moment to look around and see what items you can identify that have been discussed within this newspaper and identify what commodity, or commodities, each item comes from.

Did you Know?

One acre of soybeans can create more than 82,000 crayons. If an average box has 24 crayons, how many boxes of crayons can one acre of soybeans make? Round to the nearest whole number.

Standard CC Math: 4.OA.A.2



Link 'Ems

Agricultural commodities and their by-products are found in many common household items such as sandpaper, rayon string, packing peanuts, lotion, and crayons. Using the listed ten items, match the household products to the agricultural commodity it comes from. To learn more information about the by-product from each commodity, visit LearnAboutAg.org/resources/bites and look for the Link 'Ems.

walnut
soybean
corn kernel
wool
wood chip
lotion
crayons
sandpaper
rayon string
packing peanuts

Glossary



To request a free copy of *What's Growin' On? Extra! Extra! Extensions* to enhance the use of this newspaper, visit LearnAboutAg.org/resources/wgo/ or call (916) 561-5625.

Resources

Agricultural Marketing Resource Center
agmrc.org

Almond Board of California
almonds.com

American Soybean Association
soygrowers.com

California Apple Commission
calapple.org

California Aquaculture Association
Caaquaculture.org

California Beef Council
calbeef.org

California Department of Food and Agriculture
cdfa.ca.gov

California Farm Bureau
cfbf.com

California Forestry Association
calforests.org

California Foundation for Agriculture in the Classroom
learnaboutag.org

California Grown
californiagrown.org

California Rice Commission
calrice.org

California Pork Producers Association
calpork.com

California Poultry Federation
cpif.org

California Walnut Board
walnuts.org

California Wheat Commission
californiawheat.org

California Wool Growers
californiawoolgrowers.org

Dairy Council of California
healthyeating.org

Farmers' Rice Cooperative
farmersrice.com

Ford Motor Company
ford.com

Gills Onions
gillsonions.com

Harvard Health Publishing Harvard Medical School
health.harvard.edu

Have a Plant
fruitsandveggies.org

National Agriculture in the Classroom
agclassroom.org

National Library of Medicine
nlm.nih.gov

National Peanut Board
nationalpeanutboard.org

Sacramento Municipal Utility District
smud.org

Tomato Wellness Council
tomatowellness.com

University of California Agriculture and Natural Resources
ucanr.edu

University of California, Davis
ucdavis.edu

United States Department of Agriculture
usda.gov

United States Poultry & Egg Association
uspoultry.org

Adhesive: A substance used for placing two objects together.

Antioxidants: Vitamins and other nutrients that help protect cells in the body.

Aquatic Animals: An animal that lives in water for most or all its life, such as shellfish.

Biodegradable: The ability of an object to be broken down through the action of microorganisms. For example, paper bags are biodegradable, most plastic bags are not.

Biofuel: A fuel derived directly from living matter.

Biogas: A gas mixture, produced during anaerobic digestion that contains methane and carbon dioxide. Biogas can be burned as an energy source.

Biomass: Living or previously living material used as a renewable energy source.

Bioplastic: A group of plastics made from biological materials like plant starches, cellulose, oils, or protein.

By-products: Secondary products that are collected from the remaining materials not used in the production of an intended product.

Cereal Crops: Edible seeds or fruits of plants such as rice, wheat, corn, oat, barley, and rye used to make food or livestock feed that are also known as grain crops.

Commodities: A raw material, such as livestock, field crops, and orchard crops that are produced and harvested for an intended purpose.

Consumable: When a commodity is used for eating, drinking, or manufactured into goods.

Cultivation: The act of growing something or improving its growth.

Fiber: Thin thread of natural or artificial material that can be used to make textiles.

Fertilizer: A substance (such as manure or a chemical) that is added to soil to help the growth of a plant.

Flax: A plant with blue flowers that is grown for its fiber that is made into linen. Its seed is used for oil and livestock feed.

Generate: To bring into existence.

Legume: Plants that bear their fruit inside a pod—beans and peas are examples.

Manure: Animal waste used for fertilizing land, as a soil amendment, in construction materials, and as an energy source.

Meal: A powder-like substance made from fine particles after processing. Examples include corn meal and fish meal.

Mobile Genetics: Segments of genetics that can change places on a chromosome and be exchanged between chromosomes.

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

Pancreas: A large gland near the stomach that produces insulin and other substances that help the body digest food.

Pasteurized: A process of partial sterilization involving heat treatment to kill bacteria and make a product safe for consumption and to improve its keeping quality.

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

Pomace: The remaining pulp residue of fruits and vegetables after crushing and pressing them.

Primary Product: A finished good sold to consumers made from commodities.

Renewable Resources: Natural resources that can be replaced naturally or by human efforts at a sustainable rate. Examples: forests, fish, wildlife, plants, and animals.

Secondheads: Segments of rice, typically half of a whole kernel, that are a by-product from the rice milling process.

Shucking: The act of removing the shell of an oyster or other shellfish.

Spirulina: A blue-green microscopic aquatic algae used as a nutritional supplement.

Sustainable: Meeting the economic, social, and environmental needs of the present without compromising the needs of the future.

Swine: Another common term for a pig.

Timber: Wood that is suitable for structural uses.

Wool: A soft wavy or curly thick hair collected from animals like sheep, goats, llamas, and alpacas.

Activity

Choose ten words in the glossary and create an illustrated dictionary. Identify whether each word is a noun, adjective, or verb.
Standards: CC ELA: L.3-8.6

Top 10 Commodities for 2019



What by-products come from California's Top Commodities?

California's agriculture industry produces more than 400 different commodities, making it a \$50 billion dollar industry! Approximately one-third of the country's vegetables and two-thirds of the country's fruits and nuts are produced right here in California. Match each of California's top ten commodities to its related by-product. Draw a line from the commodity to the by-product.

10 By-products made from Commodities

- Whey Protein Powder
- Mulch (shells)
- Antioxidant Extracts
- Pomace
- Cattle Feed (Hulls)
- Compost
- Sandpaper (shells)
- Food Seasonings (skins)
- Leather (Hide)
- Compost

About California Foundation for Agriculture in the Classroom

California Foundation for Agriculture in the Classroom is a 501(c)(3) nonprofit organization that provides educators with free standards-based resources about California agriculture. The Foundation's vision is an appreciation of agriculture by all.

Contributors

- Editor: Hayley Lawson
- Executive Director: Judy Culbertson
- Graphic Design: Kelly Joseph
- Contributing Educators: Jennifer Dobbie, Melissa Driver, Christopher Lavagnino, and Carla Peterson
- Contributing Staff: Michael Ackley-Grady, Mindy DeRohan, Lyn Hyatt, and Terri Salmond



2600 River Plaza Drive #220
Sacramento, CA 95833
(916) 561-5625
LearnAboutAg.org

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