Student Edition

California Education and the Environment Initiative

4

Science Standard 4.2.a.

Plants: The Ultimate Energy Resource

California Education and the Environment Initiative

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California Environmental Protection Agency

California Natural Resources Agency

Office of the Secretary of Education

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California Integrated Waste Management Board

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California's Green Gold

Today is your birthday. You are having a party. You planned the menu by yourself. There will be pizza with lots of toppings. Your mom makes the pizza with sausage, olives, and special sauce—your favorite! She puts extra cheese on it, too. Of course, there is carrot cake for dessert. Your mom makes it with almonds instead of walnuts. The cream cheese frosting is the best.

As you walk into the kitchen, your mom looks up. "Look at all this beautiful food!" she says. "Do you know where it all comes from?"

You stop for a moment to think. You are not sure where your mom is going with this one—everyone knows food comes from the store!

"California," she says. "Everything we are eating today comes from our great state!"

"Everything?" you ask. "Even the almonds?" It is hard for you to picture all those delicious nuts growing in your own backyard.

"Yes," your mother tells you. "California grows and sells more almonds than any other place in the world."

Almonds growing on tree

One Important Nut

California is the only state that grows and sells almonds. These healthy nuts were brought from Spain in the 1700s. At first, Spanish *padres* planted the trees around the missions. The cool, damp air near the coast was not good for the almond trees. Many of

them died. A few settlers took almond trees with them when they moved inland. They found that almonds grew very well in the warm, dry weather of the Central Valley.

Today, almond farmers take special care of their trees. They wait for tiny buds to grow in the cold weather of early winter. In February, the buds open into soft pink blossoms. Soon, the honeybees begin their work. They visit each almond blossom and take a little of its sweet juice. They will use this juice, or nectar, to make honey. As they dip into the blossoms, a little pollen rubs off on the hairs on their legs. They carry this pollen with them to the next almond blossom. This is called pollination. The honeybees must pollinate the blossoms before almonds can form.

Dairy cattle

In 2006, one third of European honeybees in the United States vanished, and some growers had to import more from Europe. A drought from the previous August reduced the nectar and pollen available from late-blooming wildflowers, causing bee malnutrition over the winter. A flea-sized mite added to the honeybee's destruction. California grows virtually all of the United States' almonds and 80% of the world's supply. Due to the widespread disappearance of the honeybee, the almond crop has decreased.

Growing in California

Of course, almonds are not the only crop grown in our state. Farmers grow many kinds of crops. In fact, they grow more crops than farmers in other states. Winters are short and mild. Summers are warm, but not too hot. The growing season is very long. It is long

enough to grow some fruits and vegetables in both seasons. Lemons, artichokes, and avocados are some of them. So are broccoli, cabbage, and carrots. If you count them all, California farmers grow about 400 different kinds of vegetables, fruits, and flowers. They sell their fruits, vegetables, nuts, and honey all over the world.

Workers harvesting lettuce

Ranchers in our state also raise animals for food. Some of them raise large animals like cows and pigs. These animals are called livestock. Other ranchers raise birds like chicken and turkeys. These animals are called poultry. People that grow plants and raise animals provide food for us to eat. This is the work of agriculture.

Farming and Ranching

California is a very special place. It grows and sells more fruits, vegetables, and nuts than any other state. It has led the country for the last fifty years. Why is this? One of the reasons is that farmers in California can grow more food on less land. It could be that the winters are mild and wet and the summers, warm. This weather is perfect for growing many things. It might also be that we have many workers to help plant and harvest our crops. One thing is for sure: our state makes a lot of money selling its agricultural products.

Plants like alfalfa and hay are sold to feed cows, horses, and other large animals. Cotton is used to make clothing. Rice and beans are eaten here, and also shipped to many places in the world. It takes lots of land to grow these field crops.

If you take a drive through the Central Valley, you pass by fields of vegetables and melons. These crops are planted in thousands of straight rows. It makes you dizzy to look at them! Some

of these fields have flowers, too. Flowers and nursery plants are also important products in our state. Fruits and nuts are the state's best selling products. Grapes are the best selling fruit, and strawberries and raspberries are close behind. People from all over the world enjoy these delicious foods.

We also sell more milk and cream in California than any other state. Cheese, eggs, and yogurt are also very popular. Did you know that one dairy cow gives thousands of pounds of milk each year? Dairy cows eat lots of hay and drink gallons of water each day. All that work can make a cow very hungry and thirsty! Livestock and poultry are also important. Beef cattle, pigs, and lambs are raised for meat. So are chickens and turkeys. Ranchers use millions of acres of rangeland to raise and feed these animals.

California is one of the world's leaders in agriculture. It has the climate, the people, and the land to make it happen. However, our state is a very popular place to live. There are many people who move here each year. This causes the cities to spread into areas where crops used to grow. Land prices also rise. As people use more of the land to build houses and stores, room for growing things shrinks. This means there may be less land for agriculture in the future.

Finally, everything is ready for your party. You help your mom grate the cheese on top of the pizza.

"This cheese is from California, right?" you ask.

"Look on the label," she says. You read it aloud: "Real California Cheese."

"Where are the almonds?" you ask, hoping for a snack before your friends come. She hands them to you. The almonds are crunchy and sweet. You think for a moment how lucky you are to live in California. Every food you like is grown right here in your state!

Bees in hive

Desert Ecosystem

California has three deserts. They are the Great Basin Desert, the Mojave Desert, and the Colorado Desert. All three deserts are very dry. In fact, it can rain less than 10 inches each year. On winter nights, temperatures can fall below freezing (32° F). In summer, it is often over 100° F. Plants and animals that live in the deserts survive well in these extreme conditions.

Plants Store Water

There are many kinds of plants in the desert. Most can survive where there is very little water. Many desert plants have special ways of storing water. Some of them store water in their leaves. Some plants even have a waxy coat that keeps water trapped inside them. On other desert plants, like the fishhook cactus, hairs or spines on the stems and leaves shade the plant's stems. The prickly spines on the cactus also keep animals from eating its leaves.

Desert plants have special root systems. Some roots help the plants reach water that is deep underground. Other root systems are shallow and spread out to catch the water on the top of the ground. Plants like the barrel cactus have special stems that can expand and store water. Palo verde trees have very small leaves and so they need little water.

Animals Keep Cool

Desert animals have different ways of keeping cool and getting water. Many have light-colored coats. Light colors reflect the heat. Dark colors absorb it. Most desert animals come out at dawn or wait until the Sun goes down to look for food. They often dig burrows or stay under rocks during the day when the Sun is too hot. Some desert animals get water from eating seeds. Carnivores get moisture from eating other animals. Many desert animals only need to drink water every three to five days. Some do not need to drink at all.

Freshwater Stream Ecosystem

Streams provide homes for many special plants and animals. Not all streams are the same. Some streams are shallow and some are deep. Deep streams flow more slowly than shallow streams. Fish and other animals hide in their depths. In shallow streams, tiny plants and algae that live in the water can get more sunlight. These plants and algae change carbon dioxide and water into food for all the organisms in and around the stream ecosystem.

Trees, shrubs, and flowering plants all grow well along the banks of the stream. Here there is plenty of water and the soil is full of nutrients. Other plants live in the water. These plants need to stay near the water's surface to get sunlight. Some have wide leaves that help them float. Other plants that live in the water float because they store air in their stems. The roots of plants that live in streams hang down so they can absorb the nutrients they need from the stream.

Many Animals Use the Stream

Many animals find food and shelter in freshwater streams. Raccoons hunt crayfish from their banks. Small birds, like the American dipper, pluck insects from the bottom. Larger birds with hooked bills and sharp talons catch and eat fish from the stream. Small songbirds build nests in tree branches near the stream. They can hide from predators there.

Fish have fins that help them swim. They also have gills so they can breathe underwater. Many fish have coloring that helps them to hide from predators. Their bellies are light in color, so they blend in with the light sky when predators below them look up. They have dark upper sides, so predators looking into the dark water cannot see them from above.

Many insects live in the water of freshwater streams. Some have tiny sharp claws on their bodies. They can hold onto rocks so the flowing water does not sweep them away. Others have long legs and lightweight bodies. These insects can move along the water's surface without sinking.

Redwood Forest Ecosystem

Coast redwoods are the tallest living things on Earth. They often reach heights of 300 to 350 feet. (That is eight or nine school buses lined up end to end.) In some of the old growth forests, there are trees that are 2,500 years old.

To grow this tall, redwoods need special conditions. They must have enough water and the right temperatures. They need rich soil and shade. Almost all of the coast redwoods in the world grow in just one place. This place is along the Pacific Coast from Monterey, California, into Oregon.

In this area, the temperatures are never too hot or too cold. It rains a lot in the winter, so the trees get the water they need. It rarely rains in summer, but it can be foggy. Coast redwoods use fog to make their own "rain." Moisture from the fog gathers on the thick leaves and then drops to the ground.

A Shady Place

Coast redwoods are conifers. Conifers are trees that have cones. Seeds develop inside the cones, which protect them as they grow. Most conifers have needle-like leaves. They create a thick layer that blocks sunlight from reaching the forest floor. This keeps the forest dark, cool, and damp. Only plants that can survive in the shade grow well in redwood forests. Ferns and small berry bushes grow well under redwood trees. These plants provide food and shelter for small animals.

Redwood forests are habitats for worms, slugs, snails, and salamanders. Large animals, like elk and deer, also live in redwood forests. Some animals burrow into the soft, moist soil. Others, like spotted owls, nest and roost high in the redwood trees.

When a coast redwood dies, it falls to the forest floor and starts to decay. A fallen tree becomes a home to many insects, mushrooms, and other organisms. Some of these organisms live off the nutrients in the dead tree. Others use the parts for shelter and to lay their eggs.

Instructions: Read the **Chain Game Rules** and play the food chain game.

1. **Round 1:**
   Shuffle the cards and place them in a pile in the center. Turn the first card over. Select one person to go first.

2. On each turn, draw the top card from the pile and:
   - add the card to the beginning or end of an existing food chain (you cannot place a card between two other cards), or
   - start a new food chain

   You can also create larger chains by stacking two full chains together. (You must still play your draw card.)

3. Continue play clockwise until all the cards have been played.

4. Figure out your group score, using the following scoring rules:
   0 points for single cards;
   1 point for each two-link chain;
   2 points for each three-link chain;
   4 points for each four-link chain, and
   7 points for a five-link chain.

5. **Round 2:**
   Reshuffle the cards and begin again. Select a different person to go first. In this round, your group may work together to decide how to play each card.

This animal	might eat
barn owl	meadow voles, pocket gophers, deer mice
black bear	berries, insects
bobcat	cottontail rabbits, meadow voles, pocket gophers
California kingsnake	meadow voles, pocket gophers, rattlesnakes
cottontail rabbit	leaves, grasses
deer mouse	seeds
gray fox	berries, insects, cottontail rabbits, meadow voles
great horned owl	meadow voles, pocket gophers, deer mice, cottontail rabbits, barn owls
insects	leaves, grasses
meadow vole	grasses, seeds
mountain lion	gray foxes, bobcats, mule deer
mule deer	leaves
pocket gopher	grasses
red-shouldered hawk	kingsnakes, rattlesnakes, cottontail rabbits, deer mice, lizards
southern Pacific rattlesnake	deer mice, lizards
western fence lizard	insects

Here are some of the ways Indians in early California used the plants of the oak woodlands.

Food and Shelter

Many people lived in oak woodlands. The trees and plants provided food and shelter. People found nuts and berries to eat. They collected herbs and roots.

Acorns were a very important part of their diet. Acorns are oak tree seeds. Indians gathered them in the fall, when acorns fell from the trees. Indians could collect enough to store for later use. This was very helpful during winter, when it was harder to find food.

Acorns have chemicals in them called tannins. Tannins give acorns a bitter taste. People had to prepare acorns before eating them. First, they dried them. Then they pounded them into acorn meal. They rinsed the meal with water to get rid of the tannins. Then the acorn meal tasted sweet and nutty. People made acorn mush, bread, and soup. Today, acorns are still important to many California Indians.

turkey

steelhead trout

blackberry

mule deer

black bear

oak trees and acorns

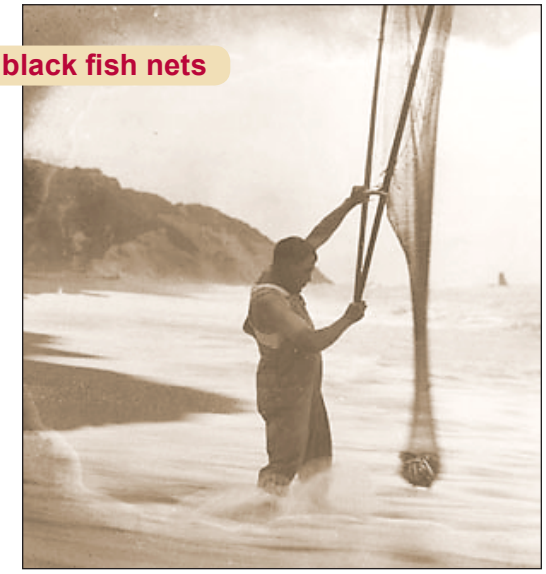
Medicine

The people used some of the plants in the oak woodlands as medicines. Parts of the oak tree were used to cure many illnesses. Some tribes made a tea from tannins in the acorns and bark. The California Indians drank the tea to help cure infections, reduce swelling, and to treat gum disease. They also put tannins on burns to help them heal faster, as well as used them on cuts and scratches to stop bleeding.

California Indian leaching acorns to make tea

Coloring

Dyes are liquids that give things color. California Indians used the juice from berries and leaves to color their clothes and other materials. They learned that, when boiled in water, the bark of some oak trees made a black dye. California Indians used this dye to weave designs into their baskets. They also dyed their fishing nets black. That way, fish could not see them. The California Indians also made dye from acorn tannins. They used the dye to soften and color animal skins.


black fish nets

baskets with designs

California Indian making basket

Ropes and Cords

The California Indians used hemp and other plants from the oak woodlands to make rope and cord. They made fishing nets and bags from cord, and tied poles together with rope. They also made traps to catch small animals with rope. Cords were used to make clothing.

Baskets were very important in their daily lives. California Indians wove baskets using rope and cord. They used these baskets to gather seeds, nuts, and other foods. They also made special baskets to cook acorns in. Some of their baskets were woven so tightly they could hold water without leaking!

iris plant

Indian hemp

sleeping mat

moccasins

Cordage

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