ABUNDANT CALIFORNIA

STRAWBERRY NO-CRUSH CHALLENGE

OVERVIEW

In this lesson, students will compare fresh and thawed frozen strawberries, and then design a way to transport fresh strawberries without crushing them. You may conduct this lesson anytime you can get fresh, ripe California strawberries from your school garden, local market, or farmers market.

GRADE LEVEL: 3–5

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CALIFORNIA FOOD
FOR CALIFORNIA KIDS®

STRAWBERRY NO-CRUSH CHALLENGE

LESSON OVERVIEW

The sight of fresh local strawberries at the market is one of the most delicious signs of spring. For many children—and many adults—strawberries are their favorite fruit.

Strawberries are very fragile. They must be picked fully ripe and are susceptible to bruising, crushing, heat, and moisture. Farmers must transport them quickly and carefully from field to market so that consumers can enjoy them at their best.

In this lesson, students will compare fresh and thawed frozen strawberries, and then design a way to transport fresh strawberries without crushing them. You may conduct this lesson anytime you can get fresh, ripe California strawberries from your school garden, local market, or farmers market.

FOOD SYSTEM EMPHASIS

Transporting

GRADE LEVEL

3–5

LENGTH

Two to three 50-minute periods

LEARNING OBJECTIVES

Students will:

- Compare the tastes and texture of fresh and thawed frozen strawberries.
- Examine informational text related to strawberry production in California.
- Design and test a way to transport fresh strawberries without crushing them.

STANDARDS CONNECTIONS

NEXT GENERATION SCIENCE STANDARDS

- 3-5-ETS1-1. Define a simple design problem reflecting a need or want that includes specified criteria for success and constraints on materials, time, or cost.
- 3-5.ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem

COMMON CORE STATE STANDARDS – ENGLISH LANGUAGE ARTS

- RL.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. RI.4.1. Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. RL.5.1. Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.

VOCABULARY

- **Achene** – a small, dry, one-seeded fruit
- **Botanist** – a scientist who studies plants
- **Fresh** – not frozen or canned
- **Fruit** – the part of a flowering plant that contains the seeds
- **Perennial** – a plant that lives and flowers for more than two years
- **Runner** - a stem-like shoot off a “mother” plant that grows a new “daughter” plant
- **Seed** – the part of a flowering plant from which a new plant can grow
- **Transport** – to move people or goods from one place to another

MATERIALS

- Copies of "10 Amazing Facts about Strawberries" and "Designing a No-Crush Strawberry Container" student handouts
- Copies of "Taste Test" and "Fruit and Vegetable Adjectives" student handouts from *Savoring California: A Comparative Tasting of California Fruits and Vegetables* (http://www.ecoliteracy.org/sites/default/files/CEL-CA-Thursdays-Tasting-Lesson.pdf)

For Taste Test

- Fresh strawberries (see Preparation)
- Frozen whole strawberries
- Knife
- Two serving trays
- Toothpicks
- Napkins

For Design Challenge

- Building materials (see Preparation)
- Fresh California strawberries (see Preparation)
- Rulers
- Stack of heavy books or other heavy object
- Watch or timer
- Sturdy chair or step stool (optional, see Preparation)
- Measuring Tape

PREPARATION

- Print copies of the student handouts. For the "Fruit and Vegetable Adjectives" student handout, you may make one copy for each table or small group, or project it onto a screen for the whole class to see.

- Obtain ripe California strawberries either from your school garden or from your local grocer or farmers market. You will need approximately half a strawberry per student for the taste test, and four strawberries per group for the design challenge.

For Taste Test

- Set aside fresh strawberries for the design challenge. Wash the remaining fresh strawberries and thaw the frozen strawberries. For both fresh and frozen, leave one strawberry whole, cut the others into bite-size pieces, and place on a serving tray. Provide toothpicks for picking up samples.

- Read over the *Savoring California: A Comparative Tasting of California Fruits and Vegetables* lesson (http://www.ecoliteracy.org/sites/default/files/CEL-CA-Thursdays-Tasting-Lesson.pdf).

For Design Challenge

- Collect building materials for student containers. Possibilities include paper cups, small boxes, cardboard tubes, interlocking building blocks, paper straws, paper clips, tape, newspaper, or plastic netting (from fruit bags). Materials should be clean so that they do not contaminate the strawberries.

- Plan how to conduct the two design challenge tests. For the squish test, students will need to place a stack of large, heavy books or other heavy object (ideally 10 pounds or more total) onto their design for 30 seconds. For the drop test, students will need to stand on a sturdy chair, stool, stairway, or balcony and drop the designs from a standard height of six feet or more onto a hard surface (such as a tile or cement floor).

SAFETY NOTES

- Have students wash their hands thoroughly before conducting the taste test.

- If anyone in the class is allergic to strawberries, you may conduct the activity with blackberries or another berry.

DIRECTIONS

1 Introduce the lesson by asking students, "How do you think strawberries get from the field to our local supermarket or farmers market?" Help students think through the various transportation modes that might be involved, including carts, tractors, trucks, trains, and planes. Encourage students to consider how delicate strawberries are and whether that might affect how strawberries are transported. Also, ask them how transportation might differ for frozen strawberries versus fresh.

2 Direct students to read the "10 Amazing Facts about Strawberries" student handout. Ask them to summarize what they read. Invite students to share any additional facts they know about strawberries, creating a class list on the board.

3 Show students the fresh and thawed frozen strawberries you have prepared for the taste test. Conduct a comparison tasting, following the suggestions in the *Savoring California: A Comparative Tasting of California Fruits and Vegetables* lesson (http://www.ecoliteracy.org/sites/default/files/CEL-CA-Thursdays-Tasting-Lesson.pdf). Encourage students to use descriptive terms for the strawberries' taste and texture, with the "Fruit and Vegetable Adjectives" student handout as a guide.

4 Lead a discussion about whether students prefer fresh or frozen strawberries, inviting them to articulate their reasoning.

5 Set up the design challenge by explaining that students will work in small groups to design and make a container or other device to safely transport four fresh strawberries from field to market. Describe the two different tests the class will conduct:

   - **Squish Test:** To simulate the crushing weight that the strawberries must withstand in a loaded truck, students will test their containers by placing them under a stack of heavy books (or other heavy object) for 30 seconds.

- **Drop Test:** To simulate the jostling that strawberries may endure on their journey, students will test their containers by dropping them from a height of six feet or more onto a cement or tile floor.

6 Show students the design materials you have collected and give each group a copy of the "Designing a No-Crush Strawberry Container" student handout. Have students fill in the two blank spaces in the test descriptions, inserting the specific weight and height they will be using. Explain that students may look at and measure the strawberries, but may not put them in their containers until the tests.

7 Encourage groups to consider the wise use of materials in their designs. Where possible, they should use recyclable materials that minimize both weight and waste.

8 Allow time for groups to plan and build their containers.

9 Gather the groups together and, one at a time, have them test their containers by inserting the four strawberries and:

- (For the Squish Test) putting containers under a stack of heavy books or other heavy weight (see Preparation); students should first use a scale to confirm the weight of the objects;
- (For the Drop Test) dropping containers from a standard height of six feet or more (see Preparation); students should use a measuring tape to ensure consistent distances.

10 Discuss the characteristics of the successful designs and whether the designs would be feasible for transporting a whole field full of strawberries.

EXTENDED LEARNING

- Collect the strawberries that survived the challenge, wash them, and make a delicious strawberry smoothie for students to enjoy. Place the strawberries in a blender with yogurt, bananas, orange juice, and crushed ice and blend until smooth.

- Use Harvest of the Month materials to explore other aspects of strawberries (see Resources).
- Read stories from *Growing the American Dream* about immigrants finding success as California strawberry farmers (see Resources).
- Watch a National Geographic video of two reporters who followed a strawberry shipping truck from California to Washington, D.C. (see Resources).
- Visit a farmers market and talk to farmers about how they transport their produce from field to market. (See Resources to locate a farmers market near you.) Discuss the best ways to get fresh produce home from the market.

RESOURCES

- *Harvest of the Month: Strawberries*. http://harvestofthemonth.cdph.ca.gov/documents/Spring/Strawberries/Strawberries%20-%20Educator%27s%20Newsletter_Final.pdf
- *Growing the American Dream: California Strawberry Farming's Rich History of Immigrants & Opportunity*. California Strawberry Commission, 2014. http://www.calstrawberry.com/Portals/0/Reports/Community%20Reports/Growing%20the%20American%20Dream.pdf.
- "Strawberry Road Trip." *National Geographic*. http://news.nationalgeographic.com/news/special-features/2014/05/140514-go-east-young-men/.
- *National Farmers Market Directory*. https://www.ams.usda.gov/local-food-directories/farmersmarkets.

ASSESSMENT

Use a rubric such as the following for students to self-assess their container designs.

	4	3	2	1
Container Design	The container is sturdily built and resists damage during squish and drop test.	Most of the container is sturdy, but there was one weak spot that caved in or tore during squish or drop test.	Some of the container is sturdy, but more than one weak area caved in or tore during squish or drop test.	The container is flimsy and fell apart easily during squish or drop test.
Wise Use of Materials	All container materials are recyclable, lightweight, and produce minimum waste.	At least two-thirds of the materials are recyclable, lightweight, and produce minimum waste.	At least one-third of the materials are recyclable, lightweight, and produce minimum waste.	Less than one-third of the materials are recyclable and lightweight. Materials produce a lot of waste.

BACKGROUND

Doubtless God could have made a better berry, but doubtless God never did.
—Dr. William Butler, 17th-century English writer, referring to the strawberry

A recent study found that for most people, strawberries evoke happy memories of early summer. In fact, 86 percent of survey respondents felt more relaxed just thinking about eating a strawberry. (Source: Macreae, Fiona. "Strawberries Are the Happiest Fruit." 17 June 2014. *Daily Mail*.)

People have been eating strawberries since ancient times, but the luscious modern strawberry we enjoy today is relatively new.

THE HISTORY OF STRAWBERRIES

Wild strawberries adapt to various climates and are native to Europe, Asia, North America, and South America. The wild fruits were often small or tough, or lacked flavor. Early Romans used wild strawberries medicinally for various ailments, including relieving bad breath, lifting the spirits, and treating a variety of infections, inflammations, and digestive complaints.

The Native peoples of North America were already eating strawberries when the Europeans arrived. They crushed the berries, mixed them with cornmeal, and baked them into strawberry bread.

The word *strawberry* in English comes from the Anglo-Saxon "streoberie." It referred either to the fact that the plants appear to be "strewn" around the field, or to the seed-like achenes on their surface that look like bits of straw.

Europeans started growing wild strawberries in their gardens in the 1300s. In the 1700s, a variety from Virginia was crossed with a Chilean variety to produce a larger, firmer strawberry known as the "pineapple strawberry" due to its noticeable flavor. In the late 1800s, the modern garden strawberry was developed in Brittany, France. Since then, hundreds of different varieties have been introduced.

Strawberries are one of the most popular fruits in the United States and beyond. According to the U.S. Department of Agriculture, Americans eat an average of 5.2 pounds of fresh and frozen strawberries per person per year.

CALIFORNIA STRAWBERRY CROP

California produces 80 percent of the strawberries grown in the United States. More than two billion pounds of strawberries are harvested in California each year and nearly 32,000 acres are devoted to strawberry production. If you placed those strawberries end to end, they would circle the Earth over 28 times. (How we calculated this: 2 billion pounds of strawberries x 15 strawberries per pound x 1.5 inches length for each strawberry = 45 billion inches of strawberries end to end. The Earth is 24,901 miles around or 1.58 billion inches. So, 45 billion inches ÷ 1.58 billion inches = 28.4.)

The leading strawberry-growing counties are Santa Barbara, Orange, Ventura, San Diego, Monterey, Santa Cruz, Fresno, and San Luis Obispo. The warm days and cool nights in these areas are ideal for growing strawberries. In addition, the generally mild California climate allows for a year-round harvest of strawberries.

HOW STRAWBERRIES ARE TRANSPORTED

Strawberries are fragile and highly perishable. Because they do not ripen any further after harvest, they must be picked fully ripe. That means that there's a short time window for them to be harvested and then transported to the farmers market or supermarket.

All strawberries are picked, sorted, and packed in the field by hand. After harvest, trays of strawberries are rushed to indoor facilities to cool them. Heat and moisture are the biggest threats to strawberries. Strawberries give off moisture that can easily bring on mold, so keeping them dry and cold (without freezing) helps to prolong their freshness. Small farming operations may have a walk-in refrigerator for this purpose. Larger operations have shipping facilities that can quickly cool strawberries to 34°F. Within 24 hours of harvest, fresh strawberries are loaded on refrigerated trucks for delivery to market.

California strawberries are shipped all over the United States. They are also exported to Canada, Mexico, and Japan. See the approximate shipping times below.

APPROXIMATE SHIPPING TIMES FROM CALIFORNIA

Seattle: 1 day
Denver: 2 days
Chicago: 3 days
Boston/New York: 4 days
Canada: 3-5 days
Mexico: 1 day
Japan (by air freight): 1 day

(Source: "Crop Profile for Strawberries in California." University of California, Division of Agriculture and Natural Resources. http://ucanr.edu/datastoreFiles/391-501.pdf.)

To keep the berries from being bruised or damaged, they are packed in trays or flats so that no berry has more than a few berries sitting on it. (They may first be placed in pulp or plastic strawberry baskets, each holding a pint or a quart of strawberries.) Flats are stacked onto pallets, with the sides of the trays bearing

the weight of the berries above. As pallets are loaded onto trucks, spacers around the flats keep them from bumping against the trucks' sides.

HEALTH BENEFITS OF STRAWBERRIES

Strawberries are rich in vitamin C. In fact, ounce per ounce, strawberries contain more vitamin C than oranges. They are also a good source of potassium, folate, and fiber. Though they are sweet-tasting, strawberries are naturally low in sugar: a one-cup serving of strawberries has only 45 calories.

SELECTING STRAWBERRIES

Strawberries are grown in California nearly year-round. When selecting strawberries for this lesson, pick ones that are plump, firm, and fragrant, with a glossy red appearance and a bright green stem cap. Avoid bruised or shriveled strawberries. For the freshest berries, purchase directly from a local grower.

Fresh strawberries should be refrigerated and eaten within two days after you buy or pick them. For best flavor, remove the berries from the refrigerator an hour or two before serving. Avoid washing them or removing their stem caps until you are ready to use them.

STUDENT HANDOUT

10 AMAZING FACTS about strawberries

1. Strawberries

aren't really berries! True berries, such as cranberries and blueberries, have **seeds on the inside.**

2. Those "seeds" on the outside of the strawberries **aren't really seeds!** Each is actually a separate dried fruit—called an achene (AY-keen—that has a seed inside it. An average strawberry holds 200 achenes.

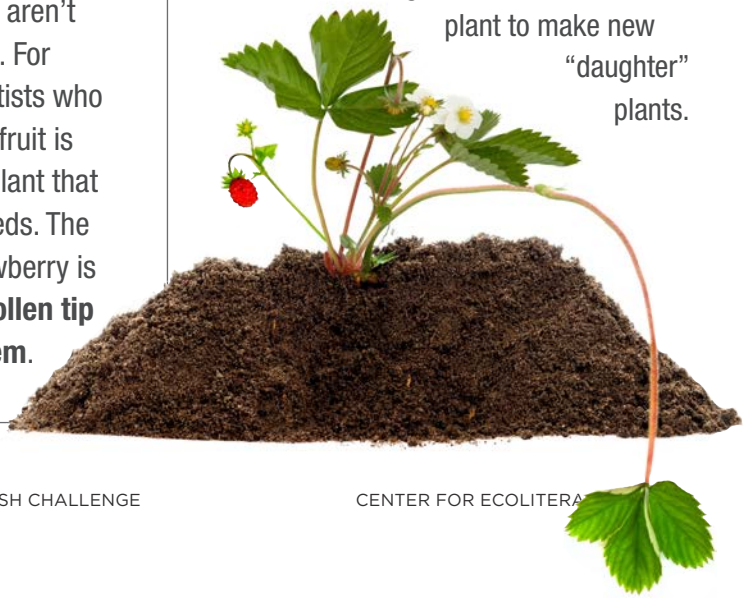
3. Strawberries aren't even a true fruit. For botanists (scientists who study plants), a fruit is the part of the plant that contains the seeds. The red, fleshy strawberry is actually the **swollen tip of the plant stem**.

4. Strawberry plants love warm, sunny days and cool, foggy nights. **California's coastal areas** are perfect for growing strawberries.

5. Strawberries are members of the **rose family**. Their cousins include apples, cherries, and peaches.

6. Strawberry are **perennials.** That means, if you plant one this year, it will grow next year and the year after that, producing strawberries for about five years.

7. Most strawberry plants don't grow from seeds, but from **runners.** These stem-like shoots grow from the "mother" plant to make new "daughter" plants.



8. California **strawberries get shipped** all across the United States and to Canada and Mexico. Some even fly by plane to Japan!

9. About two billion pounds of strawberries are grown in California each year. If you placed those strawberries end to end, they would **circle the Earth over 28 times!**

10. California

grows most of the strawberries eaten in the United States—**80 percent of them, in fact!**

NAME: _____

DESIGNING A NO-CRUSH STRAWBERRY CONTAINER

Strawberries are very fragile. They must be picked and packed by hand, since they are sensitive to bruising and crushing.

Your challenge is to build a container to transport four strawberries safely from the field to market. To test your container, you will conduct two tests:

- **Squish Test:** You will place a stack of large books weighing _____ pounds onto your container for 30 seconds. (Insert the weight.)
- **Drop Test:** You will drop your container from a height of _____ onto a hard surface. (Insert the height, including the units.)

DESIGNING AND TESTING YOUR CONTAINER

1 Decide on the size and shape of your strawberry container. Measure the width and height of each strawberry and record below (include units).

	Strawberry 1	Strawberry 2	Strawberry 3	Strawberry 4
Width				
Height				

Based on this information, the package needs to be at least _____ tall and _____ wide.

2 With your group, brainstorm designs and materials that might work for packing your four strawberries. Where possible, your materials should be recyclable and lightweight, and make little waste. Sketch your design idea and label the dimensions. Make a list of materials.

Sketch	Materials

3 Build your container according to your design idea.

4 When your teacher tells you, place your four strawberries into your container.

5 Test your container.

Squish Test: Place a stack of large books weighing _____ pounds onto your container for 30 seconds.

Results

Look at the container and note any changes (sagging, ripping, or breaking):

_____

_____

_____

Check the strawberries and note any changes (squashing or bruising):

_____

_____

_____

Drop Test: Drop your container from a height of _____ on to a hard surface.

Results

Look at the container and note any changes (sagging, ripping, or breaking):

_____

_____

_____

Check the strawberries and note any changes (squashing or bruising):

_____

_____

_____

6 Evaluate Your Container

How well would your container work to transport strawberries?

_____

_____

_____

What would you do to improve it?

_____

_____

_____

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The Center for Ecoliteracy is an internationally recognized leader in systems change innovations in education for sustainable living. Since 1995, the Center has engaged with thousands of educators from across the United States and six continents. The Center offers publications, seminars, academic program audits, coaching for teaching and learning, in-depth curriculum development, keynote presentations, and technical assistance. Books authored or coauthored by the Center for Ecoliteracy include *Ecoliterate: How Educators Are Cultivating Emotional, Social, and Ecological Intelligence* (Jossey-Bass, 2012); *Smart by Nature: Schooling for Sustainability* (Watershed Media, 2009); and *Ecological Literacy: Educating Our Children for a Sustainable World* (Sierra Club Books, 2005).

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