CALIFORNIA'S CLIMATE-SMART FARMS

STRAWBERRIES, PESTS, AND CLIMATE CHANGE

OVERVIEW

In these three activities, students explore the relationship between agricultural pests and climate change, with an emphasis on California strawberries. Each activity in the set is designed to stand alone. The activities may also be combined to make a more complex learning progression.

GRADE LEVEL: 6–8

CENTER FOR ECOLITERACY

CENTER FOR ECOLITERACY

Copyright © 2024 Center for Ecoliteracy
Published by Learning in the Real World

CALIFORNIA FOOD FOR CALIFORNIA KIDS® downloadable resource

All rights reserved under International and Pan-American Copyright Conventions. No part of this publication may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without permission in writing from the publisher.

Center for Ecoliteracy
David Brower Center
2150 Allston Way, Suite 270
Berkeley, CA 94704-1377

For more information about this activity, email info@ecoliteracy.org or visit www.ecoliteracy.org.

Learning in the Real World®

Learning in the Real World is a publishing imprint and registered trademark of the Center for Ecoliteracy, a not-for-profit, tax-exempt organization. Created in 1997, Learning in the Real World offers resources to support schooling for sustainability, stories of school communities, and the ecological framework that informs the work of the Center.

CALIFORNIA FOOD
FOR CALIFORNIA KIDS®

Table of Contents

STRAWBERRIES, PESTS, AND CLIMATE CHANGE

Summary of Activities

ACTIVITY	TIME	MATERIALS
How Are Strawberries, Pests, and Climate Change Connected? Students analyze an infographic showing the effect of climate change on agricultural pests.	• One 50-minute period	• Copies of student pages • Access to internet (optional)
Are Pesticides a Good Solution? Students plan and conduct an investigation of one or more pesticides commonly found as residue on strawberries.	• One 50-minute period to set up, plus time to observe and analyze results	• Copies of student pages • Access to internet
What Can Farmers and Individuals Do to Control Pests Sustainably? Students read a profile of Swanton Berry, which uses a variety of strategies to grow organic strawberries in the face of increased pests due to climate change. They also identify additional steps individuals can take.	• One 50-minute period	• Copies of student pages • Access to internet (optional)

Background

For many people, the sweet, juicy flavor of strawberries is the harbinger of spring. Whether eaten plain or added to shortcake or smoothies, strawberries are one of America's favorite fruits.

About 90 percent of the strawberries enjoyed in the United States are grown in California, which produces approximately 1.8 billion pounds of strawberries each year. Most are grown along the coast of Central California—from Santa Cruz County to Ventura County—where warm, sunny days and cool, foggy nights provide the best conditions for growing strawberries.

Strawberries are a delicate crop. Because they bruise easily, the fruits must be picked by hand at their perfect ripeness and handled carefully through processing, transport, and sale. The plants are also susceptible to a variety of pests and diseases, including soil-borne fungi that cause strawberry plants to wilt and die. Until a California law recently banned it, strawberry farmers routinely applied the toxic fumigant methyl bromide to kill soil fungi before planting. Methyl bromide is harmful to humans and other animals and affects the atmosphere by depleting the ozone layer that filters sunlight.

One of the effects of a general warming trend with climate change is an increase in agricultural pests. Farmers are finding that insect pests' ranges are expanding as species migrate toward the Earth's poles. Also, more insect pests are surviving the winter as frost-free periods increase, leading to longer and more intense insect outbreaks. Strawberries are likely to be particularly susceptible to these and other trends.

Organic strawberry farmers use a variety of methods to combat agricultural pests without pesticides. For example, they plant a diversity of crops; promote soil health—which boosts plants' resistance—through composting and crop rotation; use cover crops to minimize weeds and soil erosion; and encourage ladybugs and other predatory insects that eat insect pests. These farmers seek to work *with* rather than *against* nature to lessen the effects of pests and climate change.

Resources

- **Climate Change Will Exacerbate California's Insect Pest Problems.** California Agriculture. 2009. An overview of the ways that the changing climate will affect pests, this article is a meta-analysis of different studies on insect pests and climate change. http://calag.ucanr.edu/Archive/?article=ca.v063n02p73#:~:text=The%20elevated%20carbon%20dioxide%20concentrations,nonnative%20insect%20species%20into%20California
- **New Study: Eat Your Strawberries Before Climate Change Wipes Them Out.** Mother Jones. March 7, 2018. This article describes how climate change is affecting California's strawberry industry and agriculture as a whole. https://www.motherjones.com/food/2018/03/strawberries-almonds-climate-change-drought-snowpack-california-yields/
- **Time Lapse of Strawberry Plant.** This 1.5-minute video depicts the ripening of individual strawberries on a strawberry plant, and includes some insects getting into the action. https://www.youtube.com/watch?v=A_tNMJTvy7I
- **Wilted: Pathogens, Chemicals, and the Fragile Future of the Strawberry Industry** by Julie Guthman. University of California Press. This book tells the story of California's strawberry industry and its current challenges, which intersect ecology, policy, economics, and science. https://www.ucpress.edu/book/9780520305281/wilted

Extension Ideas

- Share the 10-minute video, **Some Bugs Like It Hot: Climate Change and Agricultural Pests**, which introduces students to how climate change is increasing the incidence of psyllids that cause "zebra chip disease" in potatoes. Encourage students to research other agricultural insect pests or diseases that are on the rise due to climate change. https://ca.pbslearningmedia.org/resource/e4a02ec7-a09c-495e-9157-d95f1a7fe006/some-bugs-like-it-hot-climate-change-and-agricultural-pests/
- Explore strawberry breeding with students by extracting DNA from strawberries. Discuss how selective breeding can create new varieties for pest resistance and other specific purposes. See the **Agriculture in the Classroom lesson Strawberry Breeding and Genetics** for details. https://agclassroom.org/matrix/lesson/519/
- Challenge students to plan and carry out an investigation to compare organic and conventional strawberries. They might conduct a taste test of both, compare their shelf lives, or investigate another attribute. See the journal article **Fruit and Soil Quality of Organic and Conventional Strawberry Agroecosystems** for information about one study comparing the two (which found, for example, that organic strawberries have a longer shelf life than conventional strawberries). https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0012346
- Show the 4-minute video **Growing Change** by EarthJustice, which highlights Jim Cochran of Swanton Berry Farm and talks about the importance of providing decent working conditions to farmworkers. Encourage students to identify labor issues around farmworker safety and to find out who is working to address those issues. https://vimeo.com/187257461

- Invite students to share their personal, family, or cultural stories related to farmwork through poetry, creative writing, videography, art, or other formats. Plan a celebration to present their stories.

Note: Complete activity sets for all the *California's Climate-Smart Farms* lessons are available at: https://www.ecoliteracy.org/download/climate-smart-lessons

ACTIVITY 1

How Are Strawberries, Pests, and Climate Change Connected?

Students analyze an infographic showing the effect of climate change on agricultural pests.

How Are Seeds and Climate Change Connected?

Evidence

Ever since the beginning of agriculture, farmers and gardeners have faced agricultural pests. These organisms damage crops by eating them or by causing disease or stress. Pests such as bacteria, viruses, rodents, plant-feeding insects, and mites take a big bite out of the harvest—as much as one-third worldwide.

Strawberries are particularly vulnerable to pests. The plants are prone to fungal diseases in the soil. And their fleshy fruit is easily bruised, which can lead to fruit rot.

Strawberries thrive in cool coastal climates. With climate change, air temperatures have been rising, even in the strawberry-growing regions of Central and Southern California. Heat weakens strawberry plants and makes them more vulnerable to pests and disease. It also causes an increase in the number and types of pests. The infographic on the following page describes some of the reasons for this pest increase.

GLOSSARY TERMS

Fungi (noun) A group of organisms that includes yeasts, molds, and mushrooms.

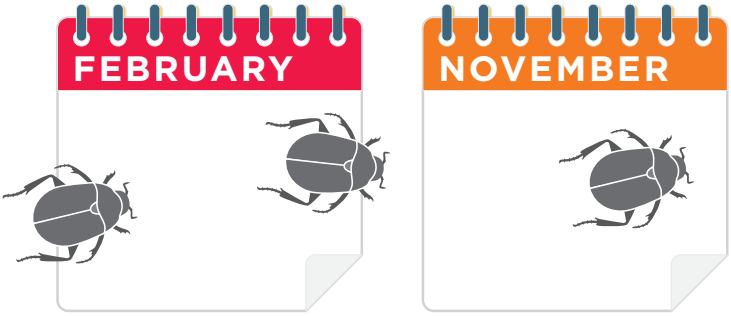
Mite (noun) A tiny animal that has eight legs and is related to spiders.

Pest (noun) An organism that destroys or damages a crop.

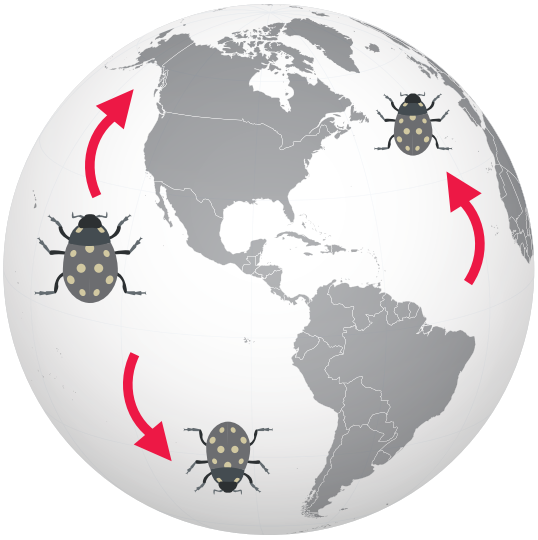
Pesticide (noun) A chemical used to kill pests.

Vulnerable (adjective) Likely to be harmed or damaged by something.

As temperatures rise, some insects:

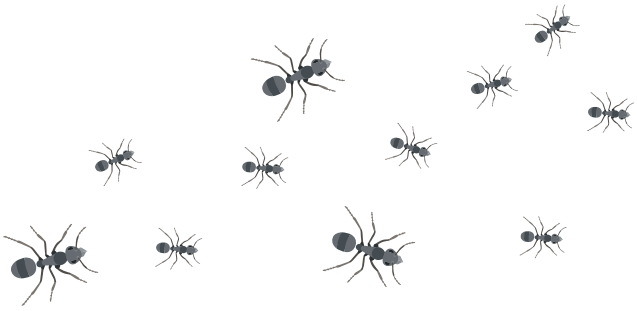


...hatch earlier, live longer, and may survive warmer winter months.



...move into new territory, including closer to the poles.

...grow larger and eat more.



...may have more than one generation per year.

...may become more resistant to pesticides.

Guiding Question: How Are Strawberries, Pests, and Climate Change Connected?

POSSIBLE ANSWERS

Look at the evidence from the previous page. **What possible answers to the question are presented?**

DIGGING DEEPER

Research to find out more about how strawberries, pests, and climate change are connected. Places to start:

- Read the article **California's Drought Has Been a Dream Come True—for Pests** to find out how warmer temperatures are increasing insect pests that can devastate California crops. https://www.theverge.com/2015/5/1/8518559/pests-insects-blight-drought-farms-california
- Look at the **Crop Fact Sheet: Strawberries** to learn how climate change affects California's strawberry industry due to pests and other threats. https://swclimatehub.info/system/files/Strawberries.pdf
- Look for insects in the garden, schoolyard, or neighborhood. Take a picture of each one you find, determine whether it is a beneficial insect or a pest, and identify ways people can encourage or control this type of insect. See the **GrowVeg** website for insect identification guides. https://www.growveg.com/beneficial-insects/us-and-canada/

Summarize what you learned:

WHAT DO YOU THINK?

Using the evidence from the previous pages and your additional research, explain your answer or solution to the question.

Claim: Write a sentence stating your answer.

EVIDENCE

Data: Include data that supports your claim.

REASONING

Explanation: Share how your evidence supports your claim.

ACTIVITY 2

Are Pesticides a Good Solution?

Students plan and conduct an investigation of one or more pesticides commonly found as residue on strawberries.

Are Pesticides a Good Solution?

Evidence

One way to combat agricultural pests is to use chemical pesticides, which are designed to kill pests. Many strawberry growers use pesticides to protect their plants and to increase their crop yield.

But pesticides can also present problems. Most are hazardous to people and animals. They can also pollute air and water, kill good bugs as well as bad ones, and create a need for more—and more powerful—toxic chemicals.

Recent analysis of U.S. fruits and vegetables shows strawberries to have one of the highest levels of pesticide residues. These residues remain on the fruit even after they have been harvested in the field and washed before eating.

Plan and conduct an investigation, such as the following, to learn about one of the pesticides that may be used on strawberries.

Workers spraying strawberry crops with pesticides.

EXAMPLE INVESTIGATION

1. Read why the Environmental Working Group selected strawberries as number one on its "Dirty Dozen" list of produce: **Pesticides + Poison Gases = Cheap, Year-Round Strawberries.** https://www.nutritioncareofrochester.com/article.cfm?ArticleNumber=37#:~:text=Fresh%20strawberries%20once%20were%20a,marketing%20campaigns%20have%20spurred%20consumption.

2. See the **What's on My Food?** website to learn what pesticide residues have been found on strawberries and other produce. http://npic.orst.edu/ingred/aifact.html

3. Choose one of the pesticides or fungicides that have been found on strawberries. Research to find out:

- Why it is used
- Its active ingredients
- How it impacts:
    - o Human health
    - o Other organisms
    - o The environment
- Alternatives to using it

Possible sources:

- **ToxFAQs.** Agency for Toxic Substances & Disease Registry. https://www.atsdr.cdc.gov/toxfaqs/index.asp
- **Active Ingredient Fact Sheets.** National Pesticide Information Center. http://www.npic.orst.edu/ingred/specchem.html

GLOSSARY TERMS

Active ingredient (noun) A chemical in a pesticide product that kills or otherwise controls pests.

Fungicide (noun) A chemical that kills fungi.

Pesticide (noun) A chemical used to kill pests.

Toxic (adjective) Poisonous.

Guiding Question: Are Pesticides a Good Solution?

POSSIBLE ANSWERS

Look at the evidence from the previous page. **What possible answers to the question are presented?**

DIGGING DEEPER

Research to find out more about whether pesticides are a good solution. Places to start:

- Find out about alternatives to pesticides that organic farmers use, such as **Organic Farming Practices.**
  https://rodaleinstitute.org/why-organic/organic-farming-practices/
- Read the article **Pesticides and Climate Change** to find out how pesticides can contribute to climate change.
  https://www.pesticidereform.org/climate-change/

Summarize what you learned:

WHAT DO YOU THINK?

Using the evidence from the preceding pages and your additional research, explain your answer or solution to the question.

Claim: Write a sentence stating your answer.

EVIDENCE

Data: Include data that supports your claim.

REASONING

Explanation: Share how your evidence supports your claim.

ACTIVITY 3

What Can We Do to Control Pests in Healthier Ways?

Students read a profile of Swanton Berry Farm, which uses a variety of strategies to grow organic strawberries in the face of increased pests due to climate change. They also identify additional steps individuals can take.

Swanton Berry Farm in Santa Cruz County

What Can We Do to Control Pests in Healthier Ways?

Evidence

Ask farmer Jim Cochran of Swanton Berry Farm his secret to sweet, delicious strawberries, and he'll say you've got to care for the Earth, the plants, and the farmworkers who tend them. When he first started farming over 35 years ago, Cochran grew strawberries using conventional farming methods. But when he became quite ill after being exposed to the pesticide methyl bromide, he began to question the chemicals he used and how they impacted both him and his workers.

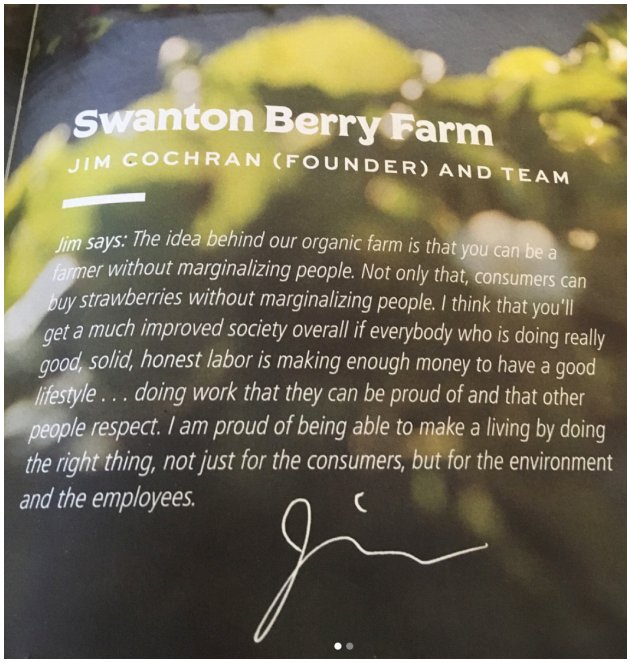
Cochrane founded Swanton Berry Farm in 1983 with the goal of providing flavorful strawberries that did not harm farmworkers' health or dignity. "From the start, everyone said it was impossible to grow a commercial crop of strawberries without chemicals," Cochran says, "because strawberries are a fragile, finicky fruit." But over the years, he has proven them wrong. His was the first organic farm in the country to grow strawberries and the first to have a union contract with workers that protected their rights.

Swanton Berry Farm manages pests in numerous ways. The farmers spend several years building the soil with compost before planting strawberries. Healthy soil means healthier plants that are naturally disease resistant. The farmers also plant strawberries in single rows, instead of the usual multiple rows, allowing more air to circulate and thus decreasing mold. And they rotate broccoli and cauliflower with strawberry crops to help control disease and pests.

These strategies continue to be beneficial, even with the changing climate. Cochran admits that "in the past couple of years yields have been way down. Climate change has been bad for business." In fact, unseasonably warm winters affect the vigor of the strawberry plants, which leads to smaller plants that are more vulnerable to pests. But the farm's holistic approach to pest management—and its proven ability to adapt—will help it face these and other new challenges with climate change.

Swanton Berry Farm:
https://www.swantonberryfarm.com/

Visitors at a U-pick event at Swanton Berry Farm.



GLOSSARY TERMS

Holistic (adjective) Dealing with the whole rather than individual parts.

Produce (noun) Fruits or vegetables that are grown for eating.

Guiding Question: What Can We Do to Control Pests in Healthier Ways?

Possible Answers

Look at the evidence from the preceding pages. **What possible answers to the question are presented?**

DIGGING DEEPER

Research to find out more about what farmers and individuals can do. Places to start:

- Use a **"Foodprint" calculator** to see how your food choices may affect the planet. https://www.earthday.org/foodprints-calculators/
- Watch the 1½-minute video **How to Protect Strawberry Crops**, which shows a couple of ways to keep slugs and birds away from strawberry plants in the garden. https://www.gardenersworld.com/how-to/grow-plants/how-to-protect-strawberry-crops/
- See the **Seasonal Food Guide** to find out when strawberries and other produce are in season where you live. https://www.seasonalfoodguide.org/veg/strawberries/california
- Look at the California section of the report **Farmworkers at Risk** to learn about the dangers to farmworkers of pesticides and heat. Then see the Policy Recommendations section to find out what our nation and state could do to reduce the risks. https://www.ucsusa.org/sites/default/files/2019-12/farmworkers-at-risk-report-2019-web.pdf

Summarize what you learned. What positive and negative effects could these actions have?

WHAT DO YOU THINK?

Using the evidence from the preceding pages and your additional research, explain your answer or solution to the question.

Claim: Write a sentence stating your answer.

EVIDENCE

Data: Include data that supports your claim.

REASONING

Explanation: Share how your evidence supports your claim.

CENTER FOR ECOLITERACY

ABOUT THE CENTER FOR ECOLITERACY

The Center for Ecoliteracy is an internationally recognized leader in education for the sustainability of people and the planet. Since 1995, the Center has engaged with thousands of educators from across the United States and six continents. The Center offers publications, seminars, coaching for teaching and learning, in-depth curriculum development, keynote presentations, and technical assistance. Our California Food for California Kids® initiative connects public school districts as they advance their work in providing students with fresh, locally-grown food and reinforcing connections between the classroom, cafeteria, and garden. With a network of over 100 public school districts across the state, California Food for California Kids helps districts share the knowledge, experience, and caring of its participants to advance practical solutions that transform school food systems and how students learn about the food they eat.

CREDITS

Author Leslie Comnes

Designer Karen Brown

PHOTOS

Swanton Berry Farm Photos courtesy Swanton Berry Farm

Student activities Karen Brown

Stock photos insects: iStock.com/Parkjisum; globe: iStock.com/WebTools; spray can: iStock.com/Nadiinko; calendar: iStock.com/ dikobraziy; strawberry: iStock.com/ilyakalinin; strawberries: iStock.com/ AlinaMD; strawberries: iStock/AbbieImages; fly: iStock.com/NERYX; strawberries: iStock.com/ bluestocking

Our deepest gratitude to Swanton Berry Farm, who shared their stories, knowledge, and photos in the development of this lesson. Their generosity and wisdom will help students understand and adapt to the challenges they may face in the future of agriculture.