Seeds to Solutions®

UNIT OVERVIEW • GRADE 8

What affects air quality in the San Bernardino-Riverside area, and what can we do about it?

Air Quality

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OVERVIEW

Unit Question: What affects air quality in the San Bernardino-Riverside area, and what can we do about it?

This curriculum starts with engaging students' prior understanding and emotions around air quality and eliciting wonder around how best to address the issue. These wonders lead to exploration of the sources of different pollutants, connections between climate change and pollutants, and the actions of people to bring awareness to the issues surrounding poor air quality.

While investigating air quality, students will

- brainstorm initial ideas and questions around poor air quality in the San Bernardino-Riverside area.
- investigate sources of air pollutants.
- explore the disproportionate effects of air pollution on marginalized communities.
- use the Class Final Explanatory Model to develop an action plan addressing one or more aspects of poor air quality in California.

Unit Home Discipline: Science

STANDARDS SUMMARY

California Environmental Principles and Concepts

➔ **Principle 4—There Are No Permanent or Impermeable Boundaries That Prevent Matter from Flowing Between Systems**
The exchange of matter between natural systems and human societies affects the long-term functioning of both.

- **Concept A.** The effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of the resulting by-products.

History—Social Science

➔ **Content Standard(s)**

- 8.3: Students understand the foundation of the American political system and the ways in which citizens participate in it.
    6. Describe the basic law-making process and how the Constitution provides numerous opportunities for citizens to participate in the political process and to monitor and influence government (e.g., function of elections, political parties, interest groups).
    7. Understand the functions and responsibilities of a free press.
- 8.8: Students analyze the divergent paths of the American people in the West from 1800 to the mid-1800s and the challenges they faced.
    2. Describe the purpose, challenges, and economic incentives associated with westward expansion, including the concept of Manifest Destiny (e.g., the Lewis and Clark expedition, accounts of the removal of Indians, the Cherokees' "Trail of Tears," settlement of the Great Plains) and the territorial acquisitions that spanned numerous decades.
- 8.12: Students analyze the transformation of the American economy and the changing social and political conditions in the United States in response to the Industrial Revolution.
    1. Trace patterns of agricultural and industrial development as they relate to climate, use of natural resources, markets, and trade and locate such development on a map.

➔ Historical and Social Sciences Analysis Skills

Historical Interpretation:

2) Students understand and distinguish cause, effect, sequence, and correlation in historical events, including the long- and short-term causal relations.

Science

This lesson builds understanding toward this/these California Next Generation Science Standards Performance Expectation(s):

- **MS-ESS3-4:** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

This lesson emphasizes these elements of the California Next Generation Science Standards:

➔ Science and Engineering Practices

- **Asking Questions and Defining Problems:**
  - Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
- **Developing and Using Models:**
  - Develop or modify a model—based on evidence—to match what happens if a variable or component of a system is changed.
  - Develop and/or use a model to predict and/or describe phenomena.
- **Planning and Carrying Out Investigations:**
  - Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions.
- **Engaging in Argument from Evidence:**
  - Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
- **Obtaining, Evaluating, and Communicating Information:**
  - Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).
  - Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence.

➔ Disciplinary Core Ideas

- **ESS2.C: The Roles of Water in Earth's Surface Processes:** The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.
- **ESS3.C: Human Impacts on Earth Systems:**
  - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
  - Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.
- **ESS3.D: Global Climate Change:** Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of

knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

➔ Crosscutting Concepts

- **Patterns:**
  - Patterns in rates of change and other numerical relationships can provide information about natural and human-designed systems.
  - Patterns can be used to identify cause-and-effect relationships.
- **Cause and Effect:**
  - Cause-and-effect relationships may be used to predict phenomena in natural or designed systems.
  - Phenomena may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability.
- **Systems and System Models:**
  - Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy, matter, and information flows within systems.
- **Stability and Change:**
  - Small changes in one part of a system might cause large changes in another part.

➔ Crosscutting Concepts

- **Influence of Science, Engineering, and Technology on Society and the Natural World:**
  - All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.

Common Core English Language Arts

- RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts.
- WHST.6-8.1: Write arguments focused on discipline content.
- WHST.6-8.9: Draw evidence from informational texts to support analysis, reflection, and research.

Common Core Math

- 6.RP.A.1: Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
- 7.RP.A.2: Recognize and represent proportional relationships between quantities.

Health Education

- 1.9P: Identify ways that environmental factors, including air quality, affect our health.
- 10P: Identify human activities that contribute to environmental challenges (e.g., air, water, and noise pollution).

BACKGROUND INFORMATION for TEACHERS

This unit is a storyline-driven curriculum that introduces students to the drivers of unequal access to clean air in California's San Bernardino and Riverside counties (San Bernardino-Riverside area). In the anchoring experience, students learn about poor air quality and high density of warehouses in the San Bernardino-Riverside area. Students then investigate the types and sources of pollutants that are the main contributors to poor air quality in the area, and specifically explore how the increase in warehouses and shipping traffic has increased fine particulate matter (PM2.5). They connect poor air quality with climate change and determine a feedback loop exists between these 2 phenomena. Students also use data to observe the effects of mountain terrain on air quality. Finally, students determine that past and current policies have shifted the burden of poor air quality onto marginalized groups but learn of ways in which these people have advocated for solutions.

Although students will learn of challenges facing the people of the San Bernardino-Riverside area, it is essential to bring an asset orientation to discussions of the area in this unit. Deficit frames that focus on what people or a community lack can contribute to dehumanization and direct attention away from real causes of problems. While recognizing that the peoples of the San Bernardino-Riverside area are facing very serious and detrimental environmental issues, particularly related to air quality, this region and its peoples, lands, waters, and life also have a rich past and present.

The San Bernardino-Riverside area was initially home to Native American tribes like the Cahuilla, Serrano, and Tongva, who lived sustainably until European colonization disrupted their way of life. After changing hands from Spain to Mexico and then to the United States, the region's land was divided and sold during the 19th century. The introduction of railroads in the late 19th century further transformed the landscape, making it accessible for farming, ranching, and industrial use. It later became a hub for agriculture and industrialization after World War II.

Today, the San Bernardino-Riverside area is a central logistics hub and home to massive warehouses. Still, its history of land appropriation and exploitation of marginalized groups continues to influence its development, leading to environmental and social issues. There are competing ideas about whether the logistics industry constitutes a net benefit or net harm to people who live in the area. Students will have the opportunity to learn about and react to some of these viewpoints.

STORYLINE

Lesson 1:
ANCHOR

Lesson Question:

How does air quality in San Bernardino-Riverside compare to other parts of California?

☐ **Session 1 • 45 min**

Students will

- Experience the Anchoring Phenomenon
- Identify Related Phenomenon
- Record Findings

☐ **Session 2 • 45 min**

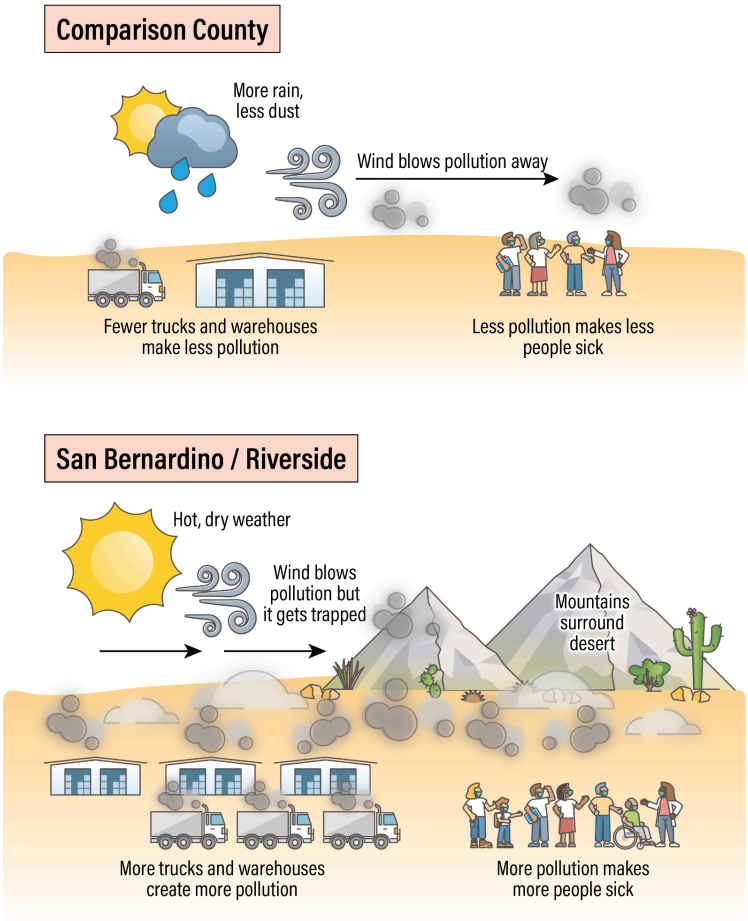
Students will

- Create an Initial Model
- Develop Driving Question Board and Next Steps
- Navigate

What students figure out:

- Air pollution is a serious problem for people in the San Bernardino-Riverside area.
- Shipping may play a part in creating the pollution.
- The San Bernardino-Riverside area is inland and away from the ocean.

Sample Initial Model:



▲ In **Lesson 1**, we *figure out* that the San Bernardino-Riverside area of California has poor air quality. *This leaves us wondering about* the indicators of air quality as we start **Lesson 2.** ▼

Lesson 2:
INVESTIGATION

Lesson Question:

What is air pollution made of, where does it come from, and what impacts does it have on people and the environment?

☐ **Session 1 • 45 min**

Students will

- Navigate
- Plan an Investigation

☐ **Session 2 • 45 min**

Students will

- Investigate Air Pollutants
- Make Sense and Update Models

☐ **Session 3 • 45 min**

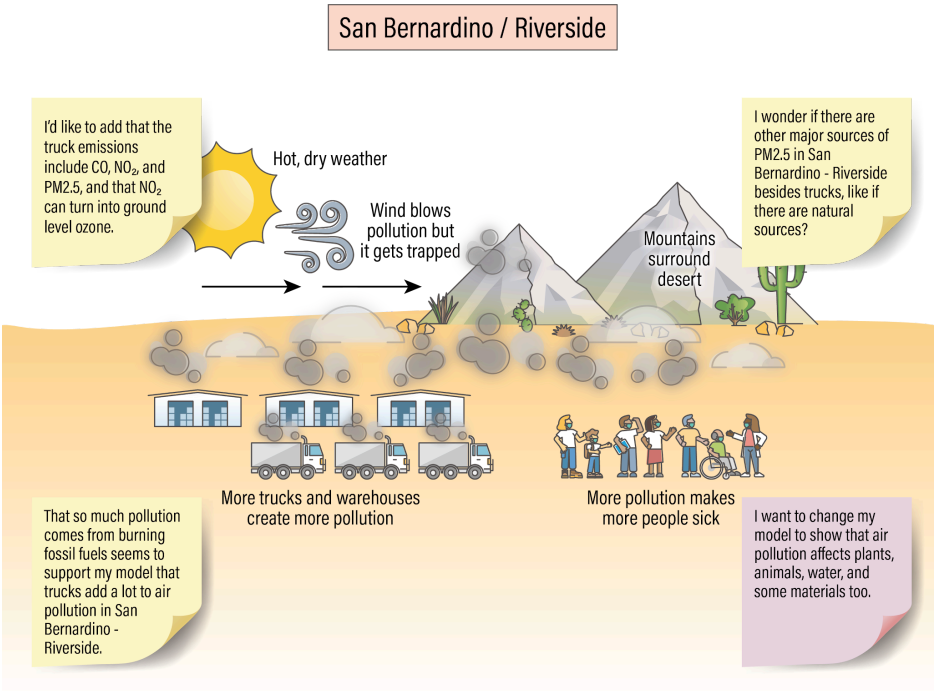
Students will

- Analyze and Interpret Data
- Navigate

What students figure out:

- Air pollution is made up of many different types of particles and gases.
- The air pollution particles come from different sources and have different effects on human and environmental health.

Sample Model:



▲ In **Lesson 2**, we *figure out* that air pollution can come in many different forms and comes from different sources. *This leaves us wondering about* the main sources of pollution in the San Bernardino-Riverside area as we start **Lesson 3.**▼

Lesson 3:
INVESTIGATION

Lesson Question:

What is causing the high PM2.5 and ground-level ozone levels in San Bernardino-Riverside and what are the impacts?

☐ **Session 1 • 45 min**

Students will

- Navigate
- Investigate Sources of PM2.5 and Ozone Part 1
- Investigate Impacts of PM2.5 and Ozone Part 2
- Check in and Preview Home Learning

☐ **Session 2 • 45 min**

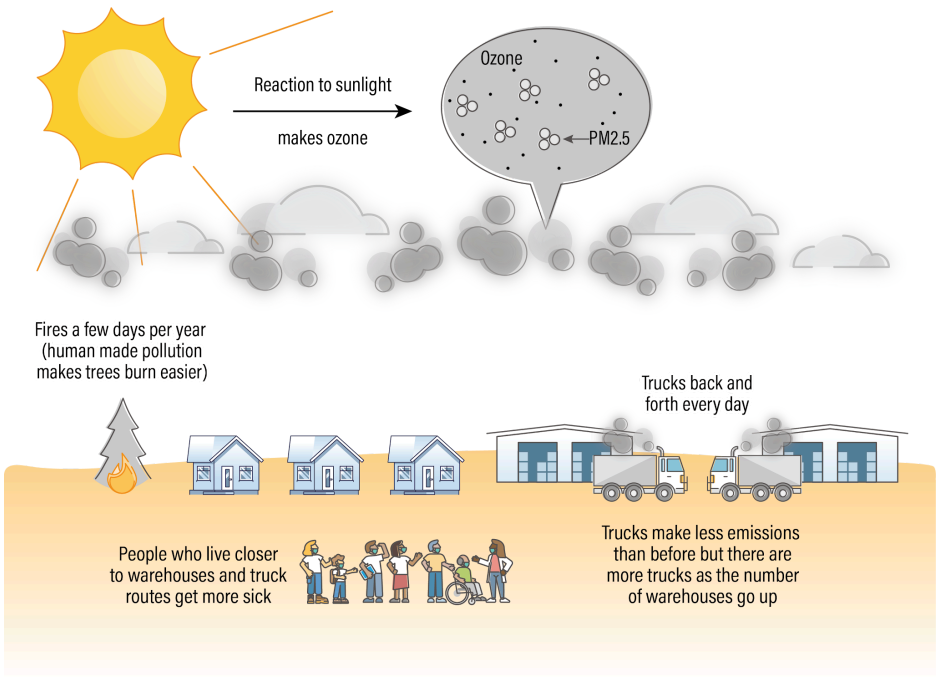
Students will

- Discuss Home Learning and Opinions on Warehouses
- Review Evidence
- Generate an Explanation
- Navigate

What students figure out:

- An increase in truck traffic from warehouses is most likely contributing the most to an increase in PM2.5 pollution in the San Bernardino-Riverside area.
- The health impacts from truck pollution impacts those closest to the warehouses, which are mostly people of color.
- Fires can also contribute a significant amount of PM2.5 pollution.

Sample Model:



▲ In **Lesson 3**, we *figure out* that truck traffic from warehouses contributes a significant amount of PM2.5 pollution into the air in the San Bernardino-Riverside area. *This leaves us wondering about* how climate change is related to poor air quality as we start **Lesson 4.** ▼

Lesson 4:
INVESTIGATION

Lesson Question:

What is the relationship between air quality and climate change?

☐ **Session 1 • 45 min**

Students will

- Navigate
- Build Shared Understanding of Climate Change
- Add Feedback Loop to Model and Explanation
- Use Model to Make Predictions

☐ **Session 2 • 45 min**

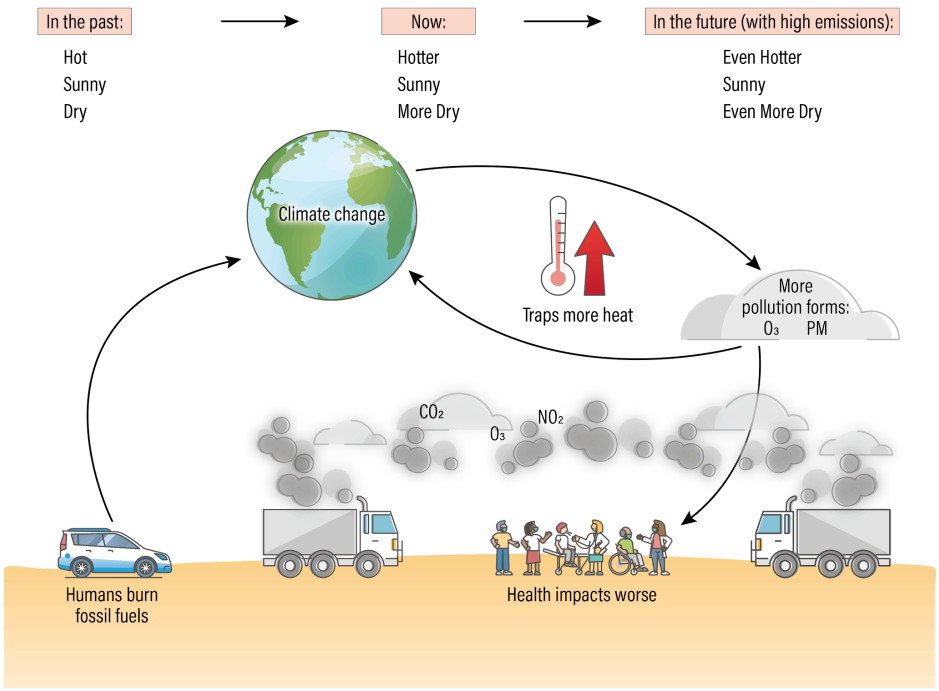
Students will

- Revisit Predictions
- Explore Health Scenarios
- Navigate

What students figure out:

- Climate change contributes to poor air quality through warmer and drier air, which makes some pollutants worse.
- Some pollutants form on hot, sunny days at ground level.
- Some pollutants act as greenhouse gases, making climate change worse.

Sample Model:



▲ In **Lesson 4**, we *figure out* that climate change increases pollutants, and some pollutants contribute to climate change, forming a feedback loop. *This leaves us wondering about* how the landscape affects pollution as we start **Lesson 5.**▼

Lesson 5:
INVESTIGATION

Lesson Question:

How do landscapes and local weather affect air quality?

☐ **Session 1 • 90 min**

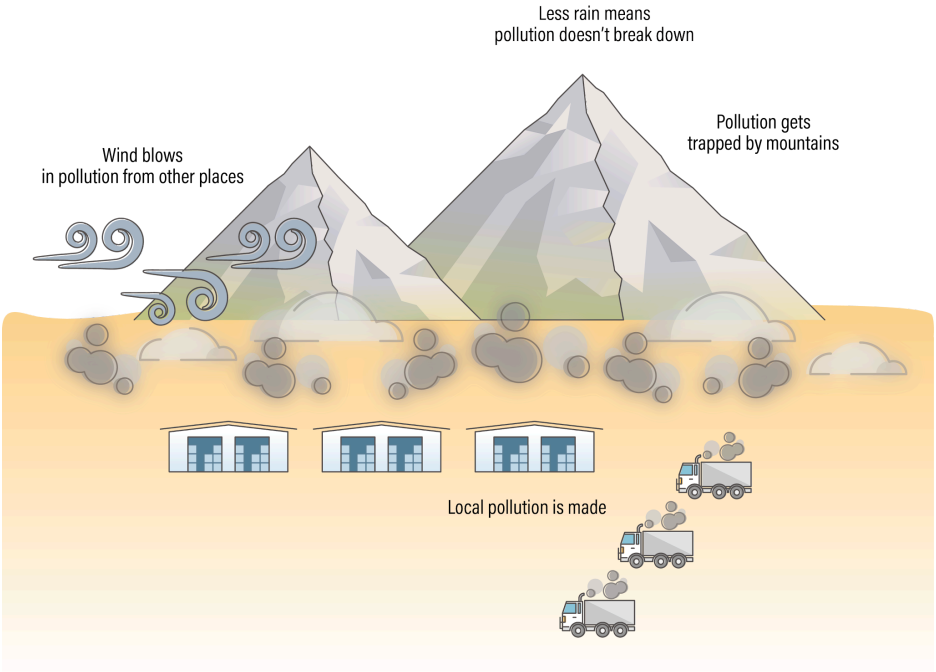
Students will

- Navigate
- Investigate Comparison Cities with GIS Maps
- Make Sense of Effects of Local Landscape and Weather on Air Quality
- Navigate

What students figure out:

- The landscape does not create air pollution, but it does affect how pollution is able to move around and helps to concentrate the pollutants.
- Without wind or precipitation, pollutants like PM2.5 can become trapped by mountains and become dense.

Sample Model:



▲ In **Lesson 5**, we *figure out* that mountains and other landscape features can trap pollutants. *This leaves us wondering about* whether or not all areas within the San Bernardino-Riverside are impacted the same by pollution as we start **Lesson 6.**▼

Lesson 6:
INVESTIGATION

Lesson Question:

How can people living so close to each other have such different experiences with air quality and climate impacts?

☐ **Session 1 • 45 min**

Students will

- Navigate
- Investigate San Bernardino and Loma Linda
- Investigate Root Causes
- Reflect on Emotions

☐ **Session 1 • 45 min**

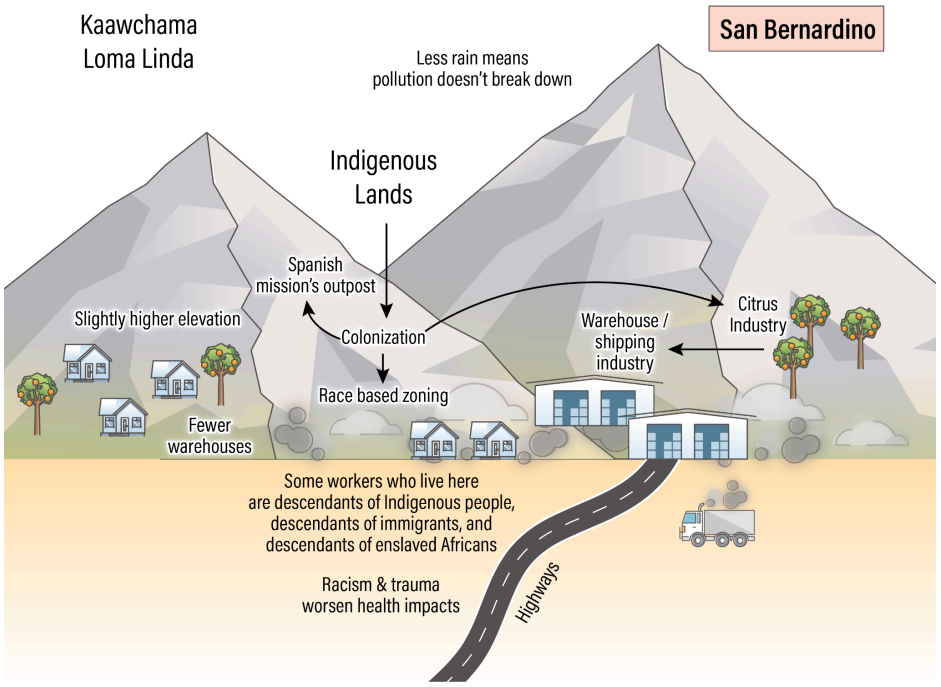
Students will

- Analyze Root Causes
- Develop an Explanation
- Navigate

What students figure out:

- Even though people may live close together, there are systemic systems in place that may contribute to different health incomes.
- More marginalized people may have poorer health because of past and current policies.

Sample Model:



▲ In **Lesson 6**, we *figure out* marginalized people within the San Bernardino-Riverside area tend to live with poorer air quality due to living closer to warehouses and other pollutant contributors. *This leaves us wondering about* what steps people have already taken to help address the issue of poor air quality in the San Bernardino-Riverside area as we start **Lesson 7.**▼

Lesson 7:
INVESTIGATION

Lesson Question:

What actions have people already taken related to air quality?

☐ **Session 1 • 90 min**

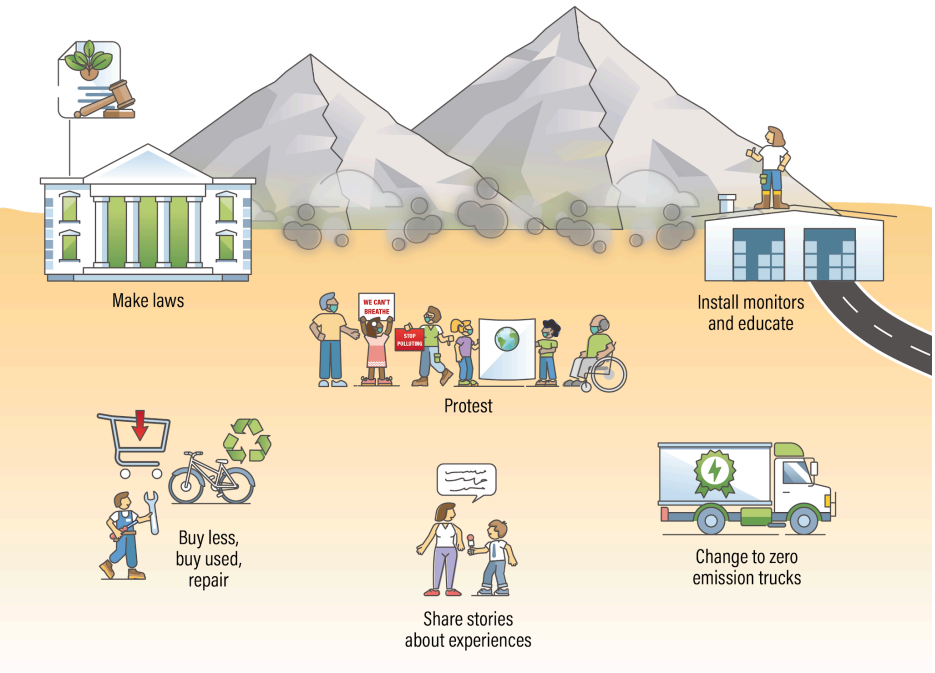
Students will

- Navigate
- Read about Air Quality Actions
- Analyze Approaches to Change-Making
- Navigate

What students figure out:

- People most impacted by the poor air quality in the San Bernardino-Riverside area have especially valuable ideas about the changes needed to solve the problem.
- Some solutions have focused on raising awareness of the air quality issues, while others have focused on the scientific or technical side of the problem.

Sample Model:



▲ In **Lesson 7**, we *figure out* that people living in the San Bernardino-Riverside area have taken many steps to help solve the issue of poor air quality. *This leaves us wondering about* what steps the class or us as individuals can take as we start **Lesson 8.**▼

Lesson 8:
CONSENSUS MODEL BUILDING

Lesson Question:

Can we explain now what affects air quality in the San Bernardino-Riverside area, and what can we do about it?

☐ **Session 1 • 45 min**

Students will

- Navigate
- Generate a Class Final Explanatory Model

☐ **Session 2 • 45 min**

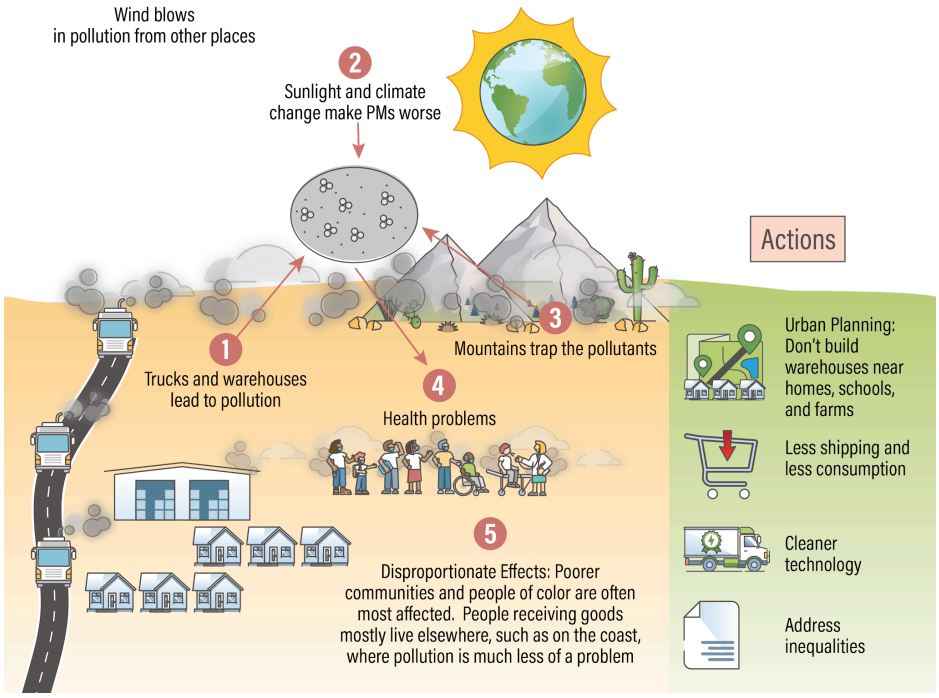
Students will

- Generate a Class Final Explanatory Model
- Navigate

What students figure out:

- Review previous lesson Model Trackers to create a list of components and interactions that have been covered throughout the unit.
- Collaboratively create a final explanatory model to answer the unit question: "What affects air quality in California's San Bernardino-Riverside area? What can we do about it?"

Sample Final Model:



▲ In **Lesson 8**, we *review* our previous model trackers and create a Class Final Explanatory Model to answer the Unit Question. We *reflect* how we might use our new understanding to take action as we start **Lesson 9.**▼

Lesson 9:
CULMINATING ENGAGEMENT

Lesson Question:

What is our relationship to the problem, and what does that mean for the actions we should take?

☐ **Session 1 • 45 min**

Students will

- Navigate
- Develop an Action Plan

☐ **Session 2 • 90 min**

Students will

- Develop an Action Plan
- Reflect and Connect

What students plan:

- Students pick an action option from the action menu or come up with their own action.
- Throughout the 2 lessons, students research, design, and execute their project and give feedback to each other's projects.

Sample Project:

▲ In **Lesson 9**, we *plan* a solution to help mitigate the effects of air pollution and climate change that builds on the ideas learned throughout the unit and incorporates equity and justice.