

Reducing Pollution and Waste

Unit 5 Overview



Unit 5 Reducing Pollution and Waste

Introduction



CHALLENGE

Create a method to reduce pollution and waste.



SCIENCE METHODS

Develop models of the water cycle and cells.



CULMINATING EXPERIENCE

Students create four-square posters highlighting their actions plans to reduce pollution and waste.

Unit Storyline

In this unit, students study pollution and waste, as well as how pollution can move from large systems such as the Earth into very small systems such as a single cell. As students study both the Earth's water cycle and the characteristics of cells, they are investigating the movement of energy and materials within these systems. In the unit's culminating experience, students work in teams to develop proposals highlighting actions to reduce pollution and waste.

This storyline graphic includes the lesson numbers of the primary phenomena, research investigations, and the themes of the unit.

5.1 – 5.6

Phenomenon:
Trash doesn't go away.



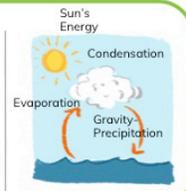
5.7 – 5.12

Phenomenon:
We are drinking the same water the dinosaurs drank!



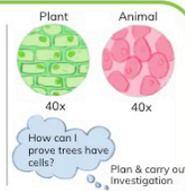
5.8 – 5.10

Investigation:
Components of the water cycle help develop a model describing the cycling of water through the Earth system.



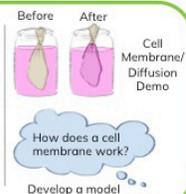
5.15 – 5.17

Phenomenon:
Trees are made of cells; rocks are not made of cells.



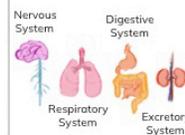
5.18 – 5.23

Phenomenon:
A cell will burst if too much water gets in.



5.24 – 5.29

Phenomenon:
Walking requires six body systems working together.



5.30

Role Playing:
Students work in groups to take on the roles of healthcare workers and assess "patients."



5.34 – 5.36

Culminating Experience:
Students create four-square posters highlighting their action plans to reduce pollution and waste.

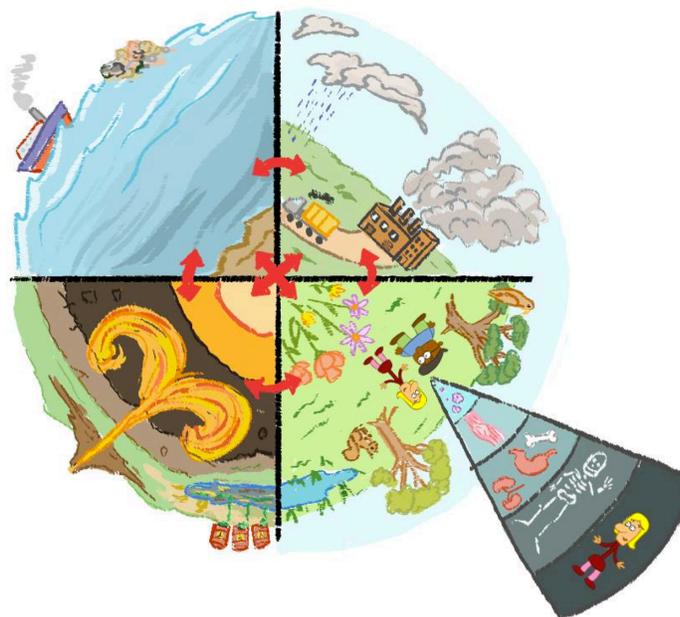


Unit Roadmap

The central theme of this unit is pollution and waste and how they move through the Earth and living systems. After students survey and categorize their own waste, they create action plans to reduce waste. Students then track the flow of waste as it moves through parts of the water cycle. By tracking the water cycle, students discover that the Earth’s systems are all connected in a web of complex relationships. Many connections occur as processes within the water cycle. Sunlight and gravity provide the energy needed to power these processes. Air, water, land, plants, and animals are in constant transition. In addition to these things moving around on Earth, pollution is also a part of the process.

Clearly, pollution is an “unwelcome guest” that is now moving freely through all Earth systems. The unit roadmap highlights the ways that pollution can move through these systems, as well as the connections between global pollution and the living cell. Students are referred to this image as a roadmap for what they’ve learned and how they will be using this knowledge in their culminating projects—creating action plans to reduce waste and demonstrating why it is important in maintaining healthy Earth and body systems.

This image can be rotated to show which processes are being reviewed in the upcoming weeks.



Science Background

Waste and pollution are major concerns for the health of Earth and its inhabitants. Humans generate over 2.6 trillion (that’s 12 zeros!) pounds of garbage each year, with over half of that going into landfills. Most of this waste comes from people living in developed countries, including countries in North America, Europe, and Asia. Managing all this waste is a huge job, and, regardless of where it ends up, trash has a negative impact on the environment. The emphasis of this unit is on solutions to the problem of excess waste through design methods that reduce waste and pollution.

Students begin the unit by building an awareness of the large amount of waste produced by humans. They do this through researching landfills, analyzing trash at their school, documenting their own waste production, and tracking the flow of waste as it moves through the Earth’s water cycle. Students follow water—and pollution—through each stage of the water cycle, identifying energy from the Sun and the force of gravity as the driving forces for each stage of the cycle. Students build concept-map models of the water cycle and extend their learning by writing comic strips chronicling the journey of a water molecule.



Students take a (very) close-up look at water as they use microscopes to zoom in on pond water and to begin investigating life too small to see with the naked eye. This leads to exploring life at the cellular level and understanding cellular structures and processes. Students develop models of cells and look at plant and animal cells under microscopes to build their understanding. Students conduct hands-on activities to identify the characteristics of living things and to describe processes, such as diffusion, that move energy and matter through them. They expand their study of cells to organs and systems and the ways these systems interact inside the human body.



Science in Action

The unit investigates solutions to trash and pollution to encourage students' interest and engagement around water and cells. This photo is an image of a magnified organism found in pond water, illustrating the complexity and beauty of even very small things.

Green Ninja Connections

In this unit, as in previous units in the Green Ninja curriculum, students are given a challenge designed to develop solutions to a problem and implement the solutions in a real-world situation. The challenge for this unit is to reduce waste and pollution. The unit begins with the *Fatal Atrashcan* video, which asks the question, “Have you ever thought about where your trash goes after you throw it away?” Students are introduced to the truth—that our trash never actually goes away! They also learn that there are ways to reduce the amount of trash we generate. The Green Ninja video *The Crude, The Bad, and The Ugly* highlights how waste can enter the Earth’s waterways, as the villain dumps used motor oil into a storm drain. In class, students examine this and other pathways for waste and pollution to enter the Earth’s waterways.



Home to School Connections

Green Ninja curriculum connects classroom learning to everyday experiences in the home. It also provides many ways for parents to stay connected to the classroom. Trash is something many people would rather not think about. But environmental scientists think about trash a lot! Now is a great opportunity for parents to model “scientific curiosity.” Help parents get their students interested in the subject of trash by being interested in it themselves.

Specific opportunities for parent involvement:

- Urge parents to help students stay up-to-date with their entries in the “trash diaries” they are maintaining.
 - [Lesson 5.1 Reducing Pollution and Waste Introduction](#) through [Lesson 5.13 Introduction to the Reducing Waste Unit Challenge Project](#)

Specific opportunities for parents to monitor student progress:

- Parents can be invited to class to see students' presentations of their four-square posters containing recommendations to reduce the impact of pollution and trash.
 - [Lesson 5.29 Body Systems Poster Session](#)

Prior Knowledge

Systems and systems models (CCC-4) are explored extensively throughout the unit. In grades 3–5, students “understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions through studying one system.” In grades 6–8, students build upon this knowledge and “understand that systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.” Students **develop and use models (SEP-2)** to represent systems and their interactions as they describe how energy from the Sun drives the cycling of water through Earth's systems. Additionally, as the unit transitions from the water cycle to cells and the body, students expand on the crosscutting concept of systems and system models as they provide evidence for how the body is a system of interacting subsystems.

Assessment

Unit 5 of Grade 6 covers a diverse set of life science and Earth science performance expectations, and there is an accompanying diversity of assessments to go along with these standards. The unit begins with a pre-assessment, which offers you an entry-level assessment to elicit students' prior knowledge about **water's role on Earth (ESS2.C)** by drawing a diagram. This activity assesses not only prior knowledge but students' ability to apply the science and engineering practice of **developing and using models (SEP-2)** to explain a process. Additionally, the pre-assessment probes students' understanding of human body systems and organization, giving you valuable insight into students' understanding of these core ideas **(LS1.A)**. During the first two lessons, you are provided with instruction on how to use the pre-assessment to gauge student progression and identify misconceptions.



Numerous opportunities for formative assessment occur through this diverse unit. The first opportunity comes in [Lesson 5.3 Researching Trash](#), in which students practice accessing legitimate websites and **obtaining and evaluating information (SEP-8)** in a research assignment. You can use this research activity to gauge how well students apply information literacy skills when obtaining knowledge about their topics. (If additional practice is needed, you can use Green Ninja skill-building lessons ([Lesson 6.4 Special Skills Lesson: Source Reliability](#) and [Lesson 5.25 Special Skills Lesson: Strategic Searching](#)) for reinforcement.) Then, [Lesson 5.5 AB-1826](#) offers an extension of the research assessment. After students **obtain and evaluate information (SEP-8)** from their research, they **engage in argument from the evidence (SEP-7)** they obtained and use this to write an opinion piece. Be sure to accept all opinions—students should be considered successful as long as they have supported their arguments with facts gleaned from their research.

Unit 5 also offers formative assessment in the form of **models (SEP-2)**. In [Lesson 5.7 Evaporation and the Water Cycle](#) through [Lesson 5.10 Runoff and Percolation](#), students build on concept maps as they explore each stage of the water cycle. Encourage students to revise and make additions as needed as they **develop their models (SEP-2)** to describe how **energy drives the motion of water (CCC-5)** as it continually cycles among land, ocean, and the atmosphere (**ESS2.C**). Then, after examining diffusion demonstrations, students are challenged in [Lesson 5.20 Modeling the Cell Membrane Part I](#) to **develop and use a model (SEP-2)** to describe the **structure and function (CCC-6)** of the cell membrane and how it contributes to the function of the cell as a whole (**LS1.A**).

Students create water-cycle comic strips in [Lesson 5.11 Water Cycle Story](#) and [Lesson 5.12 Water Cycle Wrap-Up](#) as a summative assessment of **the water cycle (ESS2.C)**. This assignment extends students' **development and use of a model (SEP-2)**, the water-cycle concept map. The rubric provided for the comic strip assignment allows you to assess how well students are able to **use their models (SEP-2)** to describe the relevant relationships between the components (water, gravity, and the Sun) and how **energy drives (CCC-5)** the **cycling of water (ESS2.C)**. Another summative assessment is found in the series of lessons on the body systems ([Lesson 5.26 Body Systems Research Part I](#) to [Lesson 5.29 Body Systems Poster Session](#)). A rubric provides you with a way to measure not only how well students accurately **obtain information (SEP-8)** from their research in order to understand the **structure and function of a body system (LS1.A)**, but also how well students are able to connect the crosscutting concept that **systems interact with other systems (CCC-4)**. Note that options for presenting reports offer differentiation for learners of different abilities.

Access and Equity

This unit on reducing pollution and waste utilizes a variety of ways for students to interact with science content, cross-cutting concepts, and practices, all of which will come in handy for diverse learners with different abilities. Several lessons involve demonstrations that will motivate learners to know more, for example, about condensation or precipitation. Some lessons engage students in authentic science practices as they examine water samples and skin cells under the microscope and make careful observations.

For students with disabilities, you may need to modify microscope set-up or even use a video scope so students can view the sample on a screen.

Science content and vocabulary are very dense in this unit, especially concerning cell characteristics and functioning. Using cut-up sentence strips to write vocabulary words for a class word bank will help EL learners. You can use sentence strips to create class concept maps too.



One powerful part of this unit is challenging students to collect data on the amount and type of waste they produce, create an action plan to reduce their waste, and then collect data again. Students who struggle with time management and motivation will need help and many reminders to keep on track with this. Be sure to post key deadlines up on the board or classroom wall to help with this. You might allow students who are EL learners to photograph what they throw away instead of describing it, or even use a digital means to record what they throw away and when.

Resources

Outside Educational Resources

You may want to meet with a water quality expert or pollution remediation expert.

- List of plastic recycling centers in California: <http://www.calrecycle.ca.gov/BevContainer/Recyclers/Directory/Default.aspx?lang=en-US>

Supplemental Resources

Lessons on body systems can be enhanced with information from credible sources such as the following:

- American Heart Association: <http://www.heart.org/HEARTORG/>
- American Diabetes Association: <http://www.diabetes.org/>
- National Institutes of Health: www.nih.gov

Library and Information Science

In Unit 5, before students do online research for the body systems poster and report, review a selection of appropriate sources, especially for medical and health topics. Students should be aware of reputable website publishers and should generally avoid sites that sell products or are discussion forums. Review with your students the different types of website domain names—i.e., **.com** for business, **.gov** for government, **.org** for nonprofit organizations, and **.edu** for educational institutions. Let your students know that a business is more likely to be biased toward the information they are presenting and possibly might want to sell you something, whereas government, nonprofit, or education organizations will more likely provide evidence-based information and are therefore more reliable.



NGSS Standards

This unit helps students develop an awareness of how much waste humans produce and the importance of reducing our waste. After **surveying (investigating) and categorizing (SEP-3)** their own waste production, students create action plans to reduce waste. Students then track the flow of waste as it moves through the water cycle by **creating a model (SEP-2)** of the **water cycle and its processes (ESS2.C)**. Through this, students discover that Earth's systems are all connected by a web of complex relationships. Students determine that sunlight and gravity provide the energy needed to power these processes (e.g., thermal energy drives evaporation, and the energy is transferred). In addition to air, water, land and living things moving around on Earth, pollution is also a part of this process.

Students use microscopes to look at pond water and begin to **investigate (SEP-3) life too small to see with the naked eye (CCC-3)**. This leads to exploring life at the cellular level and understanding **cellular structures (LS1.A, CCC-6)** and processes. Students examine the process of diffusion, which moves **energy and matter (CCC-5)** through the cell. They then **develop and use models (SEP-2)** to describe the **structure and function (CCC-6)** of the cell membrane and how it contributes to the function of the cell as a whole (**LS1.A**). They expand their study of **cells to organs and systems (LS1.B)** and the ways these **systems (CCC-4)** interact inside the human body. They do this by **researching medical cases (SEP-3)** to provide **evidence (SEP-7)** that identifies **conditions (cause)** that compromise (**effect**) (**CCC-2**) body systems and their functions.

Students end the unit with a culminating project in which they create action plans to reduce waste and explain why it is important to maintain healthy Earth and body systems.

Unit Performance Expectations

ESS2-4, LS1-1, LS1-2, LS1-3

Common Core and CA ELD Standards

In this unit, students have a variety of opportunities to practice speaking, listening, reading, writing, and computational thinking. In many lessons, students collaborate in small groups and practice speaking and listening, as in [Lesson 5.3 Researching Trash](#), in which students work together to answer questions around waste management practices and then prepare and share information in a method of their choice. In [Lesson 5.12 Water Cycle Wrap-Up](#), students complete and share water-cycle stories communicated via comic strips.

Students also synthesize information from various sources and practice writing. For example, in [Lesson 5.5 AB-1826](#), students read a legislative bill and then write an opinion paper about whether the mandates in the bill are realistic or not. In [Lesson 5.26 Body Systems Research Part I](#) through [Lesson 5.28 Body Systems Research Part III](#), students conduct research about body systems and then create reports with specified components (e.g., system organs, system functions, and so on) to teach others about these body systems.

All of these activities support Common Core State Standards (CCSS) for English Language Arts (ELA)/Literacy and California English Language Development Standards (CA ELD) for grades 6–8.



Connections to Common Core State Standards (CCSS) for Mathematics include challenging students to collect data on trash and waste, conducting an action plan based on analysis of that waste, and then collecting data again. Students compare data and communicate it in graph form in [Lesson 5.34 Reducing Waste Posters Part I](#) through [Lesson 5.35 Reducing Waste Posters Part II](#). This gives students practice summarizing numerical data sets in relation to their context by reporting the number of observations and nature of the attribute under investigation, which is a CCSS for Mathematics.

Common Core – ELA/Literacy

L.7.6, RST.6-8.2, RST.6-8.3, RST.6-8.10, SL.6.2, WHST.6-8.7, WHST.6-8.9

Common Core – Mathematics

6.SP.B.5

CA ELD

P1.6.2, P1.6.5, P1.6.8, P1.6.9, P1.6.10, P1.6.11

California’s Environmental Principles and Concepts

In this unit, students develop an understanding of three Environmental Principles and Concepts (EP&C). [Lesson 5.1 Reducing Pollution and Waste Introduction](#) through [Lesson 5.5 AB-1826](#) address **Principle V, Concept B., Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors**. Students begin to explore what happens when they “throw stuff away” by developing a *Story of Trash* model. They then research waste generation in the U.S. in order to better understand the relevance of their unit challenge—reducing the amount of waste produced. Lastly, students review past activities and learn about AB-1826, California legislation that mandates a reduction in organic materials being sent to landfills.

In [Lesson 5.6 Follow the Flow](#), students bridge the discussion from trash to water as they follow the flow of water and pollution through the water cycle. This lesson addresses **Principle IV, Concept B., There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems**. **Principle III, Concepts A. and C., Natural Systems Change in Ways that People Benefit from and can Influence**, are addressed in [Lesson 5.11 Water Cycle Story](#) and [Lesson 5.12 Water Cycle Wrap-Up](#). In these lessons, students extend their knowledge of the water cycle by creating comic strips about the journey of a water molecule through each of its stages, including how trash and pollution are moved within this cycle.

- Principle III – Natural Systems Change in Ways that People Benefit from and can Influence
 - Concept A.
 - Concept C.
- Principle IV – There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems
 - Concept B.
- Principle V – Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors
 - Concept B.

