

# Overview Air to Earth

## Scope and Sequence

### THEME

Sharing a Common Framework for a Sustainable Future

### UNIFYING CONCEPT

Consumers and industry can share concerns about and responsibility for the environment. The knowledge that Earth is a closed system can foster an attitude of stewardship toward the environment, leading businesses to create product life cycles that are profitable as well as sustainable and environmentally intelligent, and consumers to make changes as individuals or groups in ways that favor sustainable lifestyles.

### SEQUENCE OF LESSONS

#### Pre-Assessment

Students consider the five stages of a product life cycle and brainstorm ideas for managing each stage sustainably.

#### Lesson 1

Using practical examples, students understand that the earth is a closed system. Students discuss the life cycle of a shoe and consider the amount of solid waste produced if the end stage of the cycle is disposal. They explore alternatives to disposal and learn that some companies have strategies for downcycling shoes into other products.

#### Lesson 2

Students use inductive reasoning to explore four natural laws about energy conservation and photosynthesis.

#### Lesson 3

Students are introduced to Earth system conditions that must exist if a sustainable future is the goal.

#### Lesson 4

Students work in groups to reflect on the product life cycle of common household objects and of athletic shoes. They evaluate the sustainability of processes involved in the life cycles of these objects.

#### Lesson 5

A “control group” makes a model of a sports surface from recycled shoe material, using a recipe similar to that used for Nike’s playground fall protection. Other groups conduct experiments to determine how varying the recipe affects cushioning and energy return.

Students test three sports surfaces, including the model constructed in the previous lesson, for shock absorption/energy return.

#### Lesson 6

Students identify choices they make as consumers that impact the environment. They explore the possibility of making a commitment to lifestyle changes that favor sustainability.

### POST-ASSESSMENT

Students draw an enriched schema for product life cycles, one that reflects their knowledge of how companies and consumers can take responsibility for environmental sustainability if that is their goal.

# Pre-Assessment Activity

### FOCUS

To benchmark what students know about sustainably managing the components of a product life cycle.

### CONCEPT

Like living things, manufactured products have a life cycle; they impact cycles and systems on Earth. Companies can take responsibility for managing product life cycles sustainably so that resources are not depleted or permanently damaged. Consumers can take actions as individuals or as a group to practice sustainability and to influence manufacturers to produce goods in environmentally sustainable ways.

### LEARNING OBJECTIVE

#### Students

Create a schema for “sustainable” product life cycle, i.e., a systematic attempt at using resources in ways that will neither deplete nor permanently damage them.



**PREP TIME:** 5 MIN.

Make double the copies you’ll need of the diagram, located on page 65, for students to annotate. Save half for the post-assessment activity at the end of the unit. (Alternatively, make a chalkboard drawing or an overhead transparency and have students reproduce it themselves on drawing paper.)



**CLASS TIME:** 20-25 MIN.

### background

Students in primary and early intermediate grades have studied cycles and understand them as important life processes, composed of phases that eventually return to the point of origin. A leaf can illustrate this point.

#### In natural cycles,

- minerals in organic matter provide the food a tree needs to produce leaves;
- leaves, through photosynthesis, use chlorophyll and the sun to become green and grow;
- the leaves eventually turn yellow, die, and fall off to return to earth;
- they then decompose to minerals again.

The concept of cycles can also be applied to manufactured products, particularly those that can be reused, downcycled, or recycled, such as athletic shoes (see enclosed poster). This resource guide builds on students’ knowledge of cycles and asks them to think about the life cycle of any product (research and design, manufacturing, retailing, consumer use, and disposal, downcycling, or recycling) with respect to its impact on Earth systems.

**FOR MORE INFORMATION:** See **Glossary** (closed system, open system, sustainability)



### Subject Areas:

Science



Language Arts



Visual Arts



### Skills:

Discussion, creative thinking, sequencing



### Materials:

- Sample athletic shoe
- Diagram of shoe life cycle located in Resource Guide (pg 65)



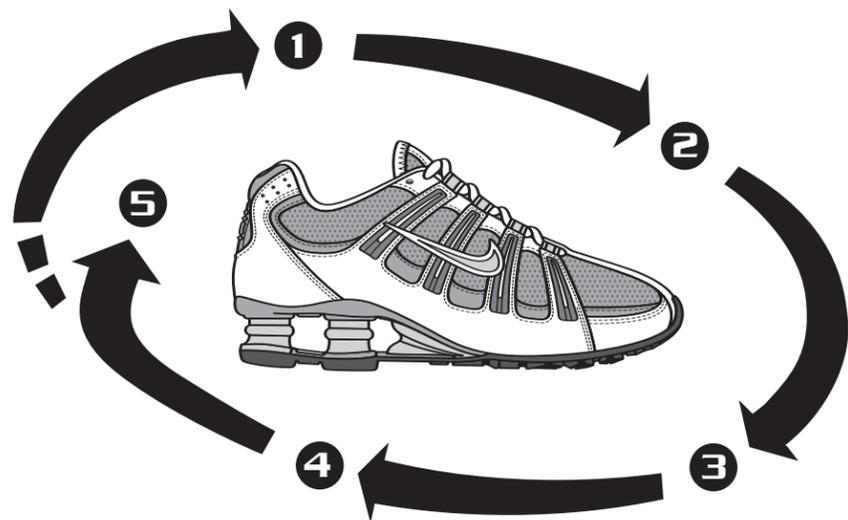
### Key Vocabulary:

sustainable (*optional*: basic names of shoe parts, such as outsole, midsole, upper)



## PROCEDURE

1. Review the concept of cycles. Ask students to name cycles they know (*examples*: the seasons, a leaf, a butterfly).
2. Tell students that all products, including athletic shoes, have a “life” cycle. Together, study a sample athletic shoe; ask how “cycle” might apply to the shoe. (Students may need prompting, such as, Where/How did this shoe get started? What happened next?, etc.)
3. Show students the diagram of the shoe’s life cycle and discuss, in a general way, some of the resources used to take this shoe from company idea to consumer product. Tell students that some companies believe that we will irreparably damage the Earth if we continue to manufacture products with no thought to conserving or replenishing resources. These companies have begun to pursue “sustainable” manufacturing: managing product life cycles so that resources are neither depleted nor permanently destroyed.
4. Tell students that they’ll be studying how consumers and businesses can practice sustainability, and that you’d like to start by seeing their ideas about how resources can be conserved at each stage of the product life cycle. What can businesses do to manage product life cycles sustainably? What can consumers do? Ask them to label their diagrams with their ideas.



## EVALUATION/WRAP-UP

Students share information on diagrams with classmates and then file them in their portfolios.

## TIMESAVER

You could start with Lesson 1 instead and assign the pre-assessment activity for homework, to be discussed the next day.

# Lesson 1

## It's a Closed System

### FOCUS

To help students visualize the consequences of a product life cycle that ends with disposal rather than with recycling or downcycling. To introduce the concept of a closed system, and the understanding that the earth is a closed system: Practically nothing comes in, with the exception of energy in the form of heat and light from the sun, and nothing leaves except heat and reflected light.

**Note to teachers:** It is true that meteors do fall to Earth and some cosmic dust enters our atmosphere, but this is nearly negligible; in general, the principles of a closed system apply.

### CONCEPTS

- Life cycles (birth decay raw material for new life) are an integral part of Earth systems: groups of interacting, interrelated, or interdependent elements that form a complex whole.
- The earth and its systems are closed to matter: i.e., matter can change form (the system is open to energy), but resources are finite.
- There is no away.
- Because the earth is a closed system, disposing of products at the end of their useful life can waste usable materials.
- Preserving resources for future generations means embracing the idea of sustainability.

### LEARNING OBJECTIVES

#### Students

- explore the concept of systems,
- examine a system familiar to them that is open,
- define the characteristics of one that is “closed,”
- compare the needs of a closed system to those of an open system,
- identify Earth as a closed system,
- describe how product cycles (in this case, shoe design, manufacturing, retailing, consumer use, and disposal) impact Earth systems (environments and societies), and
- suggest ways to reduce, reuse, or recycle resources in the life cycle for a shoe product.



**PREP TIME:** 5 MIN.

Draw a large outline of a house on the chalkboard or whiteboard. Distribute several sheets of self-sticking notepaper to students.

**PREP TIME:** 10 MIN.

Arrange desks into U-shape (you’re creating floor space for visualizing consequences of shoe disposal). Make copies of student worksheet A (optional).



**CLASS TIME:** 45 MIN.

### THERE IS NO AWAY

background

Resources taken from the Earth and manufactured into human-made products remain in Earth’s system – but generally in a highly altered form. First we call the “form” a product; then when we’ve used it up, we call it garbage. Garbage – or municipal solid waste – does not return to the Earth’s crust to feed new life forms, as would occur in natural cycles.

The Environmental Protection Agency (EPA) estimates that in 2001, U.S. residents, businesses, and institutions produced more than 229 million tons of MSW, which is approximately 4.4 pounds



### Subject Areas:

Science



Social Studies



Math



Language Arts



Economics



### Skills:



Diagramming (mapping a physical construct), discussion, creative thinking, classifying, estimating, comparing, charting/graphing, research (optional)

### Materials:



- Large plastic garbage bags
- Copies of Student Worksheet A (optional)
- Chalkboard or whiteboard
- Chalk or nontoxic dry erase markers
- Drawing paper for students; art and writing instruments (crayons, pens, markers, etc.)
- Self-sticking notepaper
- Photograph of Earth taken from outer space (optional; may be found on the Internet)
- Jar or beaker filled with water
- Dark food coloring or ink
- Ball of twine, strong yarn, or yellow construction tape for human pie chart
- Scales and rulers (optional)

### Key Vocabulary:



system, open system, closed system, resources, waste materials, sustainable, sustainability

# Pre/Post Assessment

Student Worksheet

