



We're All Connected: Earth System Interactions

Purpose

- To help students deepen their understanding of interconnections among Earth's systems.
- To help students identify processes where Earth systems are interacting.
- To provide practice in the observation and recording of natural phenomena.

Overview

One of the “big ideas” in Earth system science is the notion of interaction among parts of the Earth. In the *Elementary GLOBE* storybook *All About Earth: Our World on Stage*, the children in Ms. Patel's class discuss instances of how the four major spheres of the Earth system interact. They symbolize these interactions by using large arrows to link the system components: air, water, soil, living things, and the Sun.

In this activity, students continue to explore the idea of interaction among Earth components as they identify processes in the Earth system and indicate how they illustrate an interaction between the components of the Earth system.

Student Outcomes

After completing this activity, students will understand that Earth system interactions are all around them, going on all the time, and that Earth's processes are interconnected.

Next Generation Science Standards

- DCI ESS-2A: Earth Materials and Systems
- DCI ESS-3A: Natural Resources
- DCI LS-2A: Interdependent Relationships in Ecosystems
- Science Practice 3 Planning and Carrying Out Investigations
- Science Practice 4 Analyzing and Interpreting Data
- Science Practice 8 Obtaining, Evaluating, and Communicating Information
- Crosscutting Concept 4 Systems and System Models

CCSS.ELA Anchor Standards

- W.1 Write arguments to support claims...
- W.4 Produce clear and coherent writing...

Time

- Part 1: One 30- to 45-minute class period
- Part 2: One 30- to 45-minute class period and then periodically during the school year
- Part 3: One 30- to 45-minute class period

Level

Elementary (most appropriate for grades K-4)

Materials

- *Elementary GLOBE* storybook *All About Earth: Our World on Stage*
- Whiteboard or chart paper
- Markers
- Copies of the *We're All Connected Student Activity Sheet* (approximately five per student)
- Pencils (one per student) or colored pencils
- Optional: Several blank sheets of chart paper



Preparation

Part 1:

- Read the *Elementary GLOBE* storybook *All About Earth: Our World on Stage* – either read it to the class or have students read it to themselves. The book can be downloaded from www.globe.gov/elementaryglobe.
- Draw the *We're All Connected Chart Template 1* on whiteboard or chart paper
- Familiarize yourself with the list of *Examples of Earth system interactions* listed in the “Teacher’s Notes” section below.

Part 2:

- Make copies of the *We're All Connected Student Activity Sheet* (at least 5 copies per student)

Part 3:

- Draw the *We're All Connected Chart Template 2* on the whiteboard or on a piece of chart paper.

Teacher’s Notes

This activity includes suggestions of specific ways to record observations and interactions among the components of the Earth system and ways to discuss them, but you may come up with strategies that are more appropriate for your own situation. For example, you may want to have the students work in teams to make observations and record them. You may decide to have a regular time each day when you return to this activity, asking for an observation and then discussing the interactions it illustrates. Or, you may organize some of this work as homework, having students observe natural events near their homes. There are many good ways to modify this activity and continue to focus students’ attention on the natural world and the Earth system interactions going on there.

Background information on the components of the Earth system:

Students may have some difficulty at first in coming up with observations that can easily illustrate the major interactions, so here are some examples that

may help. The list is by no means exhaustive! Note: you don’t need to share these suggestions with your students. They are for you to use judiciously. With any luck, your students will observe all of these and more!

The Atmosphere (Air)

The atmosphere consists of the gases and particles suspended in the air. It provides the oxygen animals breathe and carries off the carbon dioxide they exhale. The atmosphere filters out most harmful forms of sunlight and traps outgoing heat from Earth’s surface. The atmosphere transports energy from the equator to the poles, making the whole planet more livable. It also brings the moisture evaporated from lakes and oceans to land in different forms of precipitation.

The Hydrosphere (Water)

The ocean, lakes, rivers, groundwater, and ice sheets (cryosphere), comprise the hydrosphere. (Note: this book doesn’t discuss the cryosphere specifically. Instead, “ice” is included in discussions about “water.”)

The hydrosphere includes water that is on or close to the surface of Earth wherever it is found. This includes water in the oceans, lakes, streams, ponds, underground, ice sheets, snow, sleet, hail, clouds, and fog. Water continually circulates between Earth’s surface and atmosphere in what is called the hydrologic cycle, or water cycle.

The Geosphere (Soil and other Earth Materials)

The geosphere includes all the solid surface of the Earth: soil, rock, sand, ocean floor, and continents. In *Elementary GLOBE*, soil is the focus of the geosphere component of the Earth system. Soil is a precious natural resource and so deeply affects every part of each ecosystem that it is often called the “great integrator.” For example, soil holds nutrients and water for plants and animals. Soil filters and cleans water that passes through it. Soil can change the chemistry of water, impact the amount of groundwater recharge, and affect the amount of water that returns to the atmosphere. The foods we eat and most of the materials we use for paper, buildings, and clothing are dependent on soil. Soil plays an important role in the amount and types of gases in the atmosphere. It stores and transfers



heat, affects the temperature of the atmosphere, and controls the activities of plants and other organisms living in the soil.

Biosphere (Living Things)

The biosphere includes all of the living things on Earth, including plants, animals, and microorganisms.

For more information about the Earth system, review the following sections of the *GLOBE Teacher's Guide* (www.globe.gov): Introduction to Earth System Science Investigations, Exploring the Connections Introduction, and Connecting the Parts of the Study Site Learning Activity.

Examples of Earth system interactions

Air ↔ Water

- Water evaporating
- Water condensing on surfaces (dew, frost)
- Clouds
- Fog
- Snow
- Ripples and waves on water caused by wind

Air ↔ Soil

- Soil drying out
- Dust swirls and dust clouds in the air
- Air warms (or cools) the soil
- Soil warms (or cools) the air

Air ↔ Living Things

- Animals taking up oxygen (respiration)
- Plants taking up carbon dioxide (respiration)
- Plants giving off moisture (transpiration)
- Smoke in the air (combustion of organic matter)

Air ↔ Sun

- Sun warms the air
- Clouds block sun
- Smog blocks sun
- Smoke blocks sun

Water ↔ Soil

- Soil getting wet
- Water eroding soil
- Soil runoff making water murky

Water ↔ Living Things

- Plants taking up moisture
- Animals drink water
- Animals exhale water vapor
- Animals and plants live in water

Water ↔ Sun

- Sun warms the water
- Warm water evaporates more readily

Soil ↔ Living Things

- Plants using soil as a foundation to grow
- Plants taking up nutrients from soil through their roots
- Animals living in soil
- Earthworms removing nutrients from soil
- Plant parts, such as leaves, decomposing to form soil
- Animals decomposing to form soil
- Waste of living things adds organic matter to the soil
- Humans make bricks using soil

Soil ↔ Sun

- Sun warms the soil

Living Things ↔ Sun

- Sun warms living things
- Sun powers photosynthesis
- Sunburn

What To Do and How To Do It

Part 1: Review and Demonstration

1. Gather the students for a discussion. Review what happened in the *Elementary GLOBE* book *All About Earth: The World on Stage*. In the book, the children in Ms. Patel's class discovered that all the components of Earth's system were important and that they interacted with each other. Air, water, soil, and living things all needed each other and were related to each other. Moreover, all the Earth system components needed the Sun (although the Sun does not need them). When the children in the book realized this, they understood better how the Earth system works. They realized that everything is related and makes a system.



- Before the students go outside to make and record their observations, model this exercise in front of the class. Ask the students whether anyone has observed something happening that they think shows an Earth system interaction. If needed, stimulate their thinking by asking, "What's going on outside these days? What have you seen happening in nature? Have you noticed any changes in nature on your way to school?" Have some of your own examples ready in case the students don't have any ideas yet.
- You can use the examples illustrated in Figure 1a and Figure 1b with your students. These examples demonstrate both a simple and more complicated way to draw connections between the different systems.

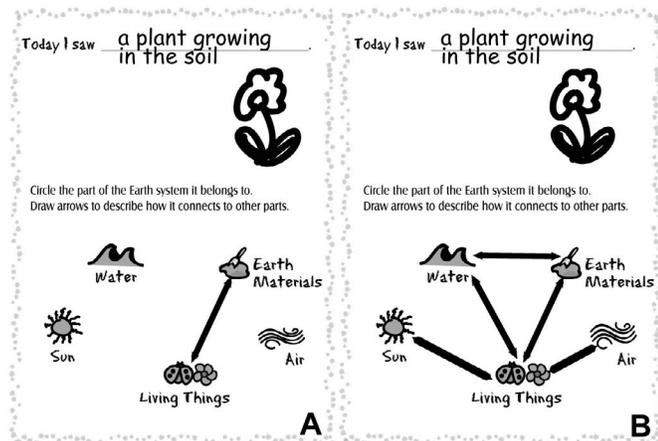


Figure 1. Examples of simple and more complicated ways to draw connections (A) A plant is growing in the soil. The soil provides nutrients for the plant and a space for the plant to grow. When the plant dies, its roots and leaves will decompose and add nutrients to the soil. (B) The soil provides nutrients for the plant and a space for the plant to grow. When the plant dies, its roots and leaves will decompose and add nutrients to the soil. Rain moistens the soil and provides water for the plant. The Sun helps the plant produce food and grow. The plant produces oxygen that animals can breathe.

- Show the class *We're All Connected Chart Template 1* drawn on the board or chart paper. Point out the Earth system components and the Sun on the chart and ask which interaction this

observation illustrates. Based on the students' answers, join those components with an arrow (or more than one arrow if that applies).

- Repeat this step several times with your students, using a different example each time. Ask the students questions about their understandings about the interactions. This way you will know when the students are ready to record their own observations of connections outside.

Part 2: Make and Record Observations

- Explain to the students that they are going to go outside and find several examples of ways that the Earth's systems interact. Every time they identify an interaction, they will record it on a copy of the *We're All Connected Student Activity Sheet* first before sharing their ideas with the class.
- You may need to assist students with their observations once they are outside. Classroom volunteers can also help with this.
- Repeat the process for additional observations on different days.
- During the remainder of the school year and as the seasons change, encourage students to watch for natural events when they are outside which illustrate different interactions. Keep a running record of the observations and the interactions they illustrate.

Part 3: Summary Chart Discussion

- After the students have recorded their observations, bring the class together for a discussion.
- Use an overhead transparency of the *We're All Connected Chart Template 2* or make your own version of the Earth system icons on the board or a chart.
- Ask the students to look over the different observations they recorded on their *We're All Connected Student Activity Sheet*. Have them take turns sharing an observation with the class. After



each observation is shared, ask the student where you should draw a two-sided arrow on the chart.

4. Either erase the arrow after discussing each observation or continue to add arrows so your students will see a web of connections at the end of the discussion.
5. Note: for younger students, use different colored markers for each arrow so they can see the different connections more easily.

Adaptations for Younger and Older Students

Younger students can play a matching game with the icons and different pictures or items from around the room. This will help students connect the object with its category. Then discuss how the different objects might interact with each other.

Further Investigations

- **Scientists' Journals:** Show your students examples of published journals some well-known scientists kept in the past. Some good examples to use are the journals of Charles Darwin, Leonardo Da Vinci, Henry David Thoreau and Merriweather Lewis & William Clark. Have the students look for examples of interactions between Earth components in these journals.
- **Play a "Name That Interaction" Game:** Students select one of the observations that have been recorded and try to name the interaction it illustrates. Write the observations on note cards and place them upside down in a "draw pile." Students or teams take turns drawing an observation and then naming the interaction it illustrates. Assign each observation notecard a number and provide an answer key that lists the correct interaction for each numbered observation card.

- **Play a "Find That Observation" Game:** Students randomly select an interaction pair (such as Sun-Soil) and then must find one of their observations that illustrates that interaction. Interaction pairs can be selected randomly in several ways: (1) make two spinners that each can point to one of the 5 Earth system components; if both spinners point at the same component, e.g. Air-Air, spin again; (2) assign each Earth system component a number from 1 to 5; roll two dice to get the interaction; roll again when you get doubles or when a six turns up (you won't use the #6 on the dice here); (3) write the interaction pairs on note cards, place cards upside down in a "draw pile" and draw one card. Depending on student ability, you can have the observations on public display for reference or they can be hidden and recalled from memory.
- **Library Visit:** Ask your school librarian what science trade books illustrate interactions in nature. Share these books with your students. Then have the students write and illustrate their own stories about interactions in nature. An adult can help younger students write down the words to their stories.

Younger students can play a matching game with the icons and different pictures or items from around the room. This way the students will be able to identify the object with its category. Then discuss how the different objects might interact with each other.

The We're All Connected Learning Activity was developed in collaboration with Harold McWilliams and Gillian Puttick from TERC, Cambridge, MA.

We're All Connected Chart Template 1

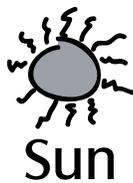
Name _____

Date _____

Today I saw _____.

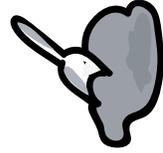
Circle the part where it belongs.

Draw arrows to describe how to connect it to other parts.

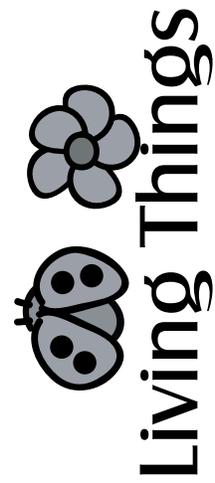
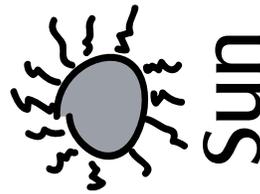


We're All Connected Chart Template 2

Draw arrows to show the connections!



Soil
and Rocks



We're All Connected Student Activity Sheet

Name _____

Date _____

This is what I saw outside:

I've circled the part of the Earth system that it belongs to below.

It connects these parts of the Earth system.

Draw arrows \longleftrightarrow to show the connections!

