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's 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 system. In the Elementary GLOBE book *All About Earth: Our World on Stage*, the children in Ms. Patel's class discuss instances of how the four major spheres of Earth's 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 two of the Earth system components.

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. They will learn how to make observations and identify the interactions they illustrate.

Science Content Standard A: Science as Inquiry
- Abilities necessary to do scientific inquiry

Science Content Standard C: Life Science
- The characteristics of organisms
- Organisms and environments

Science Content Standard D: Earth and Space Science
- Properties of Earth materials

Time

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

Level

Primary (most appropriate for grades K-4)

Materials

- Elementary GLOBE book *All About Earth: Our World on Stage*
- Overhead projector
- Overhead transparency sheets
- Markers
- Copies of the *We're All Connected Student Activity Sheet* (approximately five per student)
- Pencils or colored pencils (one per student)
- Optional: Several blank wall charts

Preparation

Part 1:

- Read the Elementary GLOBE book *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.
- Make several copies of the *We're All Connected Chart Template 1* (at the back of this activity) on overhead transparency sheets.
- Familiarize yourself with the list of *Examples of Earth system interactions* listed in the "Teacher's Notes" section below.

Part 2:

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

Part 3:

- Make a photocopy of the *We're All Connected Chart Template 1* - this can be a photocopy on an overhead transparency sheet or handwritten on the chalk board or on a piece of chart paper.

Teacher's Notes

In this activity, we have suggested 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 ways 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 ways you can modify this activity and continue to focus students' attention on the natural world and the Earth system interactions that are occuring.

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: we do not suggest that you provide these to the 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 oceans, inland water bodies, ground water, and ice sheets (cryosphere), comprise the hydrosphere. (Note: *All About Earth: Our World on Stage* 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 the entire solid surface of the Earth: soil, rock, sand, ocean floor and continents. 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 and impact the amount that recharges the groundwater or returns to the atmosphere to form rain. 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 this content area, 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 turbid (cloudy)

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.

2. 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.

3. 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.

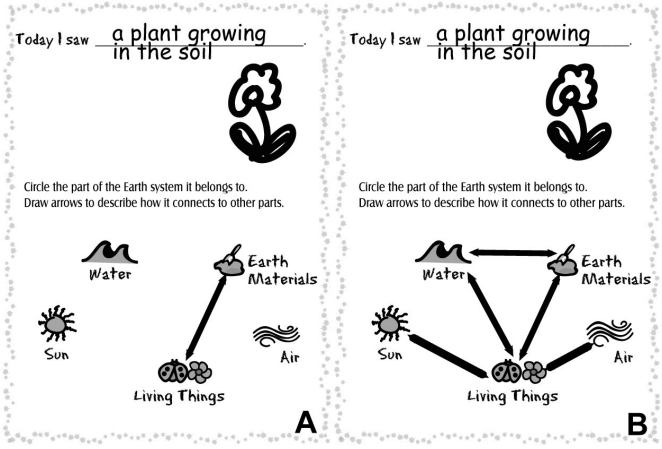


Figure 1. Examples of simple and more complicated ways to draw connections (A) A plant is growing in the soil. The soil provides nutrients for the plant and a space for the plant to grow. When the plant dies, it's roots and leaves will decompose and add nutrients to the soil. (B) The soil provides nutrients for the plant and a space for the plant to grow. When the plant dies, it's 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.

4. Use an overhead transparency of the *We're All Connected Chart Template 1* to record the observation you are discussing with your students (both write and draw your observation). Point out the five Earth system components 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).

5. Repeat this step several times with your students, using a different example each time. Ask the students questions about their understandings of 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

1. 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.

2. You may need to assist students with their observations once they are outside. Classroom volunteers can also help with this.

3. Repeat the process for additional observations.

4. During the remainder of the school year and as the seasons change, encourage students to watch for natural events when they are outside that illustrate different interactions. Keep a running record of the observations and the interactions they illustrate.

Part 3: Summary Chart Discussion

1. After the students have recorded their observations, bring the class together for a discussion.

2. 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.

3. 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 Earth system icons and different pictures or items from around the room. This way the students will be able to identify the object with its part of the Earth system. 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 note card 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 which 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.

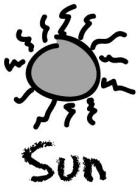
The "We're All Connected Learning Activity" was developed in collaboration with Harold McWilliams and Gillian Puttick from TERC, Cambridge, MA.

We're All Connected Chart Template 1

Date: _____

Today I saw _____.

Circle the part of the Earth system it belongs to.
Draw arrows to describe how it connects to other parts.



We're All Connected Chart Template 2

Draw arrows to show the connections!

NAME:_____

We're All Connected Student Activity Sheet

Date: _____

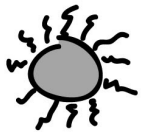
This is what I saw outside:

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

It connects these parts of the Earth system.
Draw arrows ⟷ to show the connections!


Water


Earth Materials


Sun


Air


Living Things