My NASA Data - Lesson Plans

What Is Earth System Science?

Grade Band

- 3-5

Time

- > 90 minutes

Overview

This lesson introduces the Earth system science spheres through model making and discussion. Students will work within an Earth system science notebook to chronicle their work and learning. In small groups, students will examine photographs and conduct a photo sort of examples from the geosphere, biosphere, hydrosphere, and atmosphere. Student groups will classify these examples into categories and provide category titles as they are introduced to the scientific vocabulary. Students will then construct two types of conceptual ESS models. Classroom discussions will deepen this conceptual understanding by comparing and contrasting the models and discussing the advantages of each as tools for understanding the complexities of our Earth system.

Materials Required

- Image of Earth from space
- Whiteboard for writing notes on ESS model whole-class discussion.
- Student science notebooks
- ESS Graphic Organizer printed for each student science notebook

Per group:

- “ESS Picture Sort” worksheet
- Sorting page
- Colored picture sheet
- Scissors
- Glue stick
- Tape
- Paper model supplies:
- Four strips of construction paper: dark blue, green, brown, and light blue

- Two cap circles made of cardstock, staples or brads, markers

Balloon model supplies:

- One round balloon
- Multiple 60 cm. yarn pieces in four colors? dark blue, green, brown, and light blue

Teacher Preparation:

- Organize students into groups of two or three students.
- Print the ESS picture sort sheet and sorting page for each group.
- Print ESS Graphic Organizer for each student
- Prepare materials as listed above, each group may make one or two models
- Build samples of each model to gently guide student work
- Review the background information and the NASA resources.
- Familiarize yourself with the vocabulary words.
- Designate a bulletin board in the classroom called Earth System Science to post resources and share learning examples collected over time during the unit.

Procedure

See Teacher Handout (PDF) for full lesson plan and student handouts.

NGSS Three Dimensional Learning

NGSS Disciplinary Core Ideas

- ESS1C: The History of Planet Earth

NGSS Crosscutting Concepts

- Systems and System Models

NGSS Science and Engineering Practices

- Asking Questions and Defining Problems
- Developing and Using Models
- Planning and Carrying out Investigations
- Analyzing and Interpreting Data
- Constructing Explanations and Designing Solutions
- Obtaining, Evaluating and Communicating Information

Learning Objectives

Students will:

- Identify and sort images of the four spheres that comprise Earth system science.

- Collaborate to build different models to represent ESS.
- Compare and discuss the usefulness of each model for understanding the interconnections of the four spheres in ESS.
- Use their science notebooks to explain ideas and vocabulary by recording, illustrating and labeling their thinking.

Essential Questions

- How can a model of the Earth's four spheres deepen our understanding of Earth system science?
- How does understanding the Earth as a system affect our human behavior?
- How can daily observations of the natural world help you be an Earth system scientist?

Teacher Background Information

Historically, it has been challenging for humans to observe and think about the Earth as a whole because humans are small and the Earth is so large to us. Yet, with the advancement of science and views of the Earth from space, scientists have been able to think more about the Earth working together as a system. 5th-grade students will make and explore two different models of Earth system science, then use their critical thinking skills to compare the attributes of their two different models.

NASA's (2003) definition of Earth system science explains:

> *Earth is a dynamic planet? the continents, atmosphere, oceans, ice, and life ever changing, ever interacting in myriad ways. These complex and interconnected processes comprise the Earth system, which forms the basis of the scientific research and space observation that we refer to as Earth system science.*

Satellite data and images have changed our understanding of Earth, humans are now better able to see and study the Earth in its entirety. Scientists increasingly understand that the Earth functions together as a single system and this newly accepted understanding is bridging the discrete fields of science that were developed in the 1800s and 1900s. NASA is now looking at data collected by satellites orbiting the Earth to monitor the vital signs of the Earth and measure the changes that are occurring on a global scale. Closely monitoring these interconnected Earth spheres of the hydrosphere, atmosphere, geosphere, and biosphere is a way to understand patterns, monitor changes, and make predictions to plan for the future.

Introducing the concepts of ESS to children at the elementary level provides them with the opportunity to develop a conceptual understanding of the Earth as a single functioning system. This interdisciplinary approach has been supported with Next Generation Science Standards specifically addressing the elementary students' need to understand the basics of ESS. Later, in high school and college, many science students may enter courses that study single disciplines such as biology, hydrology, chemistry, and meteorology. With the foundation they were given at the elementary level to understand Earth as a single functioning system, they will perceive the interconnections and approach problem-solving from the viewpoint of the integration of the four Earth spheres.

Teacher Resources

- Lesson Plan