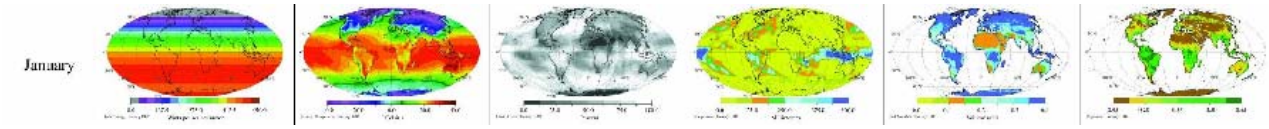
Earth as a System Learning Activity

Activities to accompany the GLOBE Earth System Poster



Purpose:

To identify global patterns and connections in environmental data contained in the GLOBE Earth Systems Poster; to develop an understanding of the interactions of Earth systems.

Overview:

Maps displaying global environmental data through the course of a year are compared in order to understand how the Earth works as a system.

Student Outcomes:

Science Concepts

Earth and Space Science

- Students will be able to explore the concepts of Earth as a System.
- Students will be able to find patterns and connections between and among maps containing different environmental data.
- Students will understand the relationship between time and space in regard to global environmental data.

Scientific Inquiry Abilities:

- Discover, analyze, and interpret patterns in a graphic display of data.
- Analysis of mapped data.
- Develop descriptions and explanations using evidence.
- Communicate observations and explanations.

Level:

Secondary

Time:

One to two class periods.

Materials and Tools:

- One "GLOBE Earth System Poster." This poster can be found on the GLOBE Web site at <**www.globe.gov/fsl/educornimages/poster_letter_color.jpg**>.
- Scissors

Background:

The processes comprising the global environment are interconnected. Understanding how these connections operate on a global scale is to understand the Earth as a system. Understanding the Earth as a system requires a quantitative exploration of the connections among various parts of the system. These processes take place in the atmosphere, oceans, fresh water, ice, soil, and vegetation. These processes also include energy from the Sun and the gases and particles that enter the atmosphere and oceans from both space and layers of molten and solid rock beneath the Earth's surface.

The following activities will help students to understand variations in environmental parameters by examining connections among different phenomena measured on local, regional and global scales. As students look at the connections between and among environmental data, they will gain a perception that the environment is the result of the interplay among many processes that take place on varying time and spatial scales.

Preparation:

Cut the GLOBE Earth System Poster into:

- The 36 global data maps:
  6 – Solar Energy; 6 – Average Temperature; 6 – Cloud Cover; 6 – Precipitation;
  6 – Soil Moisture; 6 – Vegetation
- The 6 Data type labels (Solar Energy, Average Temperature, Cloud Cover, Precipitation, Soil Moisture, Vegetation)
- The 6 Month labels (January, March, May, July, September, November)

Note: Lamination of the various maps and labels can ensure many uses.

Procedures:

Activity 1 – Exploring a Single Map

1) Arrange students into 6 groups (preferably no more than 4 students in a group).
2) Provide each student with one global data map corresponding to the data type labels as shown in the table below (I.e., each student in Group One receives a global data map of Solar Energy, each student in Group Two receives a global data map of Average Temperature, etc.):

GROUP	Data Type Label
One	Solar Energy
Two	Average Temperature
Three	Cloud Cover
Four	Precipitation
Five	Soil Moisture
Six	Vegetation

3) Ask students to study and interpret their data maps.
4) Ask the six groups, one at a time, to share with the entire class the information provided on their data maps. Use the following guiding questions:
   - *What is the range of values shown on the scale bars on each map?*
   - *Where in the world do you find the highest and lowest values of the data on your map? Where are the extremes? Why do these locations experience the extremes and not other locations?*
   - *Are any patterns in the data noticeable? Are patterns different on different continents? Different over water than over land? Explain these patterns.*

Activity 2 – Exploring Annual Changes in a Data Type

1) Distribute all global data maps of each data type to groups designated in Activity 1.
2) Have groups arrange their maps in chronological order, beginning with January.
3) Ask groups to identify annual cycles for their data type. Use the following guiding questions:
   - *What changes do you see through the year? What seasonal changes and annual cycles emerge? What explanations can you suggest for these patterns?*
   - *Choose a location or region. During which months do the extreme highs and lows occur? What explanations can you suggest for the timing of those extremes?*
   - *Which regions experience both the extreme highs and lows? Which regions don't experience the extremes? Why do you think this occurs?*
   - *What differences, if any, do you find between the year's variations over the oceans versus the year's variations over the continents?*
   - *Are there regions that remain relatively unchanged over the year? Why do you think this occurs?*
4) After several minutes, ask the groups to share with the entire class their discoveries of patterns and their interpretation of those patterns.

Activity 3 – Exploring Relationships Between Two Data Types
(Follows Activity 2)

1) Instruct groups to come together in the following pairs:
   - Group One (Solar Energy) with Group Two (Average Temperature)
   - Group Three (Cloud Cover) with Group Four (Precipitation)
   - Group Five (Soil Moisture) with Group Six (Vegetation)
2) Have groups arrange their data maps in chronological order for each data type.
3) Have groups line their data maps next to each other (January next to January, etc.).
4) Ask groups to identify the relationships and associations between the data types. Use the following guiding questions:
   - *What relationship do you see between solar energy and average temperature? Cloud cover and precipitation? Soil moisture and vegetation?*
   - *Are the relationships proportional or inverse?*
5) After several minutes, ask groups to share with the entire class the relationships they have identified between the two data types. Have them also share the methods they used to identify these relationships.

Activity 4 – Exploring Relationships Among Data Types for a Particular Month

1) Collect all data maps from the groups.
2) Ask students to reform their 6 original groups (See Activity 1, Step 1).
3) Distribute the Month labels to each group as shown in the following table:

GROUP	Month Label
One	January
Two	March
Three	May
Four	July
Five	September
Six	November

4) Redistribute the global data maps to groups according to month. Groups receive all six data types for their month.
5) Ask students to identify relationships among data for each month. Use the following guiding questions:
   - *Which regions experience the extreme highs and lows for each data type?*
   - *Which regions don't experience the extremes? Why do you think this occurs?*
   - *What differences, if any, do you find between variations of data types over the oceans versus variations in data types over the continents?*
   - *What amounts of solar energy, temperature, cloud cover, precipitation and soil moisture characterize the world's most vegetated regions for a particular month?*
6) After several minutes, ask groups to share with the entire class their discoveries of patterns and their interpretations of those patterns.

Activity 5 – Exploring Relationships Among Data Types Six Months Apart

1) Instruct groups to come together in the following pairs:
   - Group One (January) with Group Four (July).
   - Group Two (March) with Group Five (September).
   - Group Three (May) with Group Six (November).
2) Have groups line their global data maps next to each other by data type (Solar Energy January next to Solar Energy July, Average Temperature January next to Average Temperature July, etc.).
3) Ask students to identify the changes that occur in the data types over the six-month period. Use the following guiding questions:
   - *What data types have the largest variations over the six-month period? The smallest variations? Why do you think this is occurring?*
   - *Do you see any relationships among the data types that you didn't see previously?*
4) After several minutes, ask groups to share with the entire class the relationships they have identified among the data types. Have them also share the methods they used to identify these relationships.

ASSESSMENT

Assessment Activity – Applying the Data

1) Have students look at data types that are six months apart, or have them look at all the global data maps put in order by data type and month (they could also look at an uncut GLOBE Earth System Poster).
2) Ask them to use the global data maps or the Earth System Poster to answer the following questions:
   - *If global cloud cover were reduced by 25%, what changes would you predict for the equatorial region of Africa? Why would you predict those changes?*
   - *Choose a location where you would like to go on vacation. What is the best month to visit that location? Why?*
   - *If you were to go on vacation in May, where would be the best location for your trip? Answer the same question for the other 5 months available.*
3) Have participants justify their answers by referencing the specific data types and months that helped them formulate their responses.

EXTENSION

Extension Activity – Sequencing Annual Changes in a Data Type

1) Cover the dates on the global data maps.
2) Distribute the data maps (in random order) by data type to groups of students.
3) Ask students to arrange the maps in order.
4) After several minutes, ask students to share with the entire class the methods and patterns they used to place the maps in order without date information.
5) Have students uncover the dates on the maps to check their order. Have them discuss the difficulty or ease of arranging the data maps.