



Global Greenup Lesson Plan

Overview

Students will observe how the vegetation in a particular region of the Earth changes with the seasons. When viewed from space, seasonal vegetation change can be tracked across entire continents, and large scale "green-up" or "brown-down" of regions over time can be explored. Students will use satellite images to think about how animal migrations might be linked to seasonal changes, as reflected in the changing vegetation of the Earth.

Suggested Lesson Sequence	Please see the Seasonal Changes and Migrations del Mundo module descriptions.
Lesson Level	Intermediate
Science Connections	<ul style="list-style-type: none"> Students will investigate changes in the Earth's vegetation across seasons. Students will learn about the "green-up" and "brown-down" of vegetation on a global scale. Students make the connection between the color of the Earth (as observed from space) and the season of the Earth at that time and location. Students will recognize from satellite images that different seasons (e.g. summer and winter) occur on the globe at the same time.
Math Connections	<ul style="list-style-type: none"> Students will identify patterns and changes in the vegetation of the Earth as inferred from satellite images. Students will create representations of seasonal changes in vegetation by recording color changes on a data table.
Technology Connections	<ul style="list-style-type: none"> Students will use satellite imagery to observe changes in the Earth's vegetation.
Lesson Assessment	<ul style="list-style-type: none"> Assessment and Standards Table (Word) Assessment Activity Description (below) Authentic Assessment (below)

Materials

This lesson requires Powerpoint Reader ([Windows](#) / [Mac](#)), and [Quicktime Player](#).

Crayons (dark green, light green, brown, light brown, black, white for each student)
Computer (projection device or large screen TV recommended)
Global Greenup Data Table ([Word](#)) - one per student
Global Greenup Questions ([Word](#)) - one per student
Slides of the Seasons interactive slideshow ([Powerpoint](#))
Global Greenup movie ([Quicktime](#)), narrated by Pixel the Satellite

About the slideshow: this slideshow is not meant for students to read through on their own. It is intended to be viewed together, to outline and illustrate a discussion of the lesson's themes, led by the teacher. You might have a different student read each slide's text.

Vocabulary Words

Green-up: the process which occurs when plants develop new leaves in the springtime. Another term for "green-up" is "leaf flush."

Brown-down: the process which occurs when plant leaves turn from green to yellow or brown. This process can happen when little water is available (summer), after a plant produces a seed (summer or fall), or temperatures become cooler (fall).

Vocabulary Note: students may be unfamiliar with other vocabulary presented in this lesson. This is done intentionally, to spur additional conversations and discussion about these words and their meanings. Encourage your students to ask about words they may be unfamiliar with.

I. Assessing Prior Knowledge

Begin a class discussion about the types of changes that occur over the course of a season. Several other lessons in the ESC curriculum (e.g. [The Biological Clock](#), [Playground Changes](#), [Playground Greenup](#)) are designed to have students explore seasonal changes. If you have done any of these lessons with your students, this would be an excellent time to brainstorm about what the students remember about their previous seasonal observations. Similarly, as this lesson will show that seasonal changes in vegetation can be observed on a global scale through satellite imagery, you may wish to refresh students' memory about any satellite-related lessons they have done and/or images they have seen, and what the colors in those images represent.

In particular, encourage children to think about how vegetation changes during the year and how animals respond to seasonal changes. For example, children may note the grass turns brown in the winter and green in the spring or that some trees change colors in the fall or lose their leaves in the spring. In the winter, some animals such as squirrels may nest; others such as birds may migrate.

II. Contextual Preparation

Get your students excited about beginning this lesson's activities by playing the [Global Greenup](#)

[Movie](#), starring Pixel the Satellite. The transcript to this movie follows:

"1. Ahhhh...the four seasons: salt, pepper, cinnamon, and nutmeg. 2. Oh, those aren't 4 seasons, they're 4 seasonings! 3. Can you tell me what the four seasons are? (Pixel looks as if he's listening to the kids...waits for a moment) 4. That's right . . . spring, summer, fall, and winter! 5. I have a great job, orbiting the Earth all year round, because I get to see how the Earth changes as the seasons change. 6. Did you know that I can see changes in the seasons from all the way up here in space? 7. In this lesson, you'll get to see a whole years' worth of Earth pictures taken by one of my satellite friends, and you'll use these pictures to track the changes in the globe's colors through time. 8. What could those color changes mean? 9. Your teacher will help you get started with that-- in the mean time, I'm off to see some glaciers in Alaska! 10. See you soo-oon!!!!

II. Student Activities

1. On a computer screen or projector, show the twelve-month, [Slides of the Seasons](#) sequence of images of the Earth. (As an alternative, students may view the sequence on individual machines). When clicking quickly through the slides, changes in the color of the Earth's surface appear to move seamlessly from one to another (depending on where on the globe you are looking). It is important to note the dates of each image as shown in the calendar in the upper left corner of each slide.

Teacher background: This slide show depicts a map of the Earth that looks "lobed." Students may ask why this map looks different than others they may be familiar with which do not have any "holes." The reason for this particular map shape is that, when a spherical object such as the globe is viewed in two dimensions, the flat map will either have some "holes" or the features on the map will be "stretched" to fill these holes. A similar phenomenon can be seen when peeling an orange and then laying the continuous peel flat. To further explore this phenomenon with your students, you can do the [Patchwork of the Planet](#) lesson.

In addition, students may ask about the changing blackness on the image map. The black on the map arises from the fact that the poles are dark in the winter, and therefore satellite data is not available for these areas. To further explore this with your students, you can do the [Lights, Camera, Action!](#) lesson.

2. You may wish to show the image sequence more than once. Be sure that students focus on different parts of the Earth on each successive viewing. (For example, they might want to watch how places in North America, the Antarctic, Siberia, the Sahara, etc. change over time.) After viewing the animated satellite images, generate a discussion around questions such as the following:

- What types of patterns or changes in vegetation do you see?

Different color changes on the images show changes in vegetation growth according to seasonal change. A green-up occurs when plants are actively growing during warmer seasons with adequate rainfall. A brown-down is when plants are dormant during cold or dry seasons.

- Where do you notice the most drastic changes in color throughout the year? What regions of the Earth do not seem to change much throughout the year?

Students should observe that the most dramatic color changes take place in regions where there is seasonal change in climate. Regions such as deserts experience less change in seasons because of the dry and warm climate throughout the year.

- What does each different color represent?

Green is indicative of plant growth; white shows areas of snow cover. Black suggests that there was not enough sunlight at that time and location to capture an image (see the [Lights, Camera, Action!](#) lesson).

4. After the class discussion of the images, students may be broken into small groups, and should be given the [Global Greenup Data Table](#) and crayons including dark green, light green, brown, dark brown, white and black. The activity requires students to select two locations on the globe that they will observe carefully as the [Slides of the Seasons](#) image sequence is shown again. One location should be the approximate location of the city in which the children live. For the second location, the children may choose any other place else on the globe, preferably on a continent other than North America. They should write in the name of the location they have chosen (as specifically as they are able) in the space designated on the activity sheet.
5. The [Global Green-up Data Table](#) may be used to help students observe the green-up/brown-down process at each of the two locations they have selected. To do so, students will the [Slides of the Seasons](#) images again, pausing long enough to observe the color of Earth at their two locations on each date. Students should select a crayon that best represents the color they see on the slide for the date listed in the table for both locations: their hometown, and the other location they selected. The students should then color in the corresponding cell on the activity sheet that best matches the color observed in satellite image.
6. Distribute the [Global Greenup Questions](#) sheet. Students may work in small groups or with the teacher in whole class discussion to answer the [Global Greenup Questions](#). In answering these questions, students must refer to the [Global Greenup Data Table](#).

Questions for Class Discussion:

1. What colors did you observe throughout the year at your home location?
Answers will vary.
2. What colors did you observe throughout the year at your second location?
Answers will vary.
3. What do you think each color on the satellite image represents?

Green = active plant growth

Yellow/Brown = plants are dormant in colder seasons and not actively growing.

White = represents snow cover

4. What seasons do you think it is when you see brown? White? Green?

Brown = late fall or winter

White = winter or early spring

Green = early fall, spring or summer

5. What do you think causes the green-up or brown-down of the continents seen on the satellite imagery?

Green-up is caused by the warmer temperature and greater water availability that is conducive to plant growth. Brown-down of plants is caused by cooler temperatures and drier climates.

6. What can you say about the seasons of the year in the two locations you looked at most closely?

Answers will vary depending on locations. If children selected locations in the northern and southern hemisphere, then they should note that while it may be winter in the northern hemisphere, in the southern hemisphere it is summer (or vice versa)

7. Compare your results with somebody who chose a location on a different continent. How are your findings related? How are they different? Why?

Answers will vary depending on location.

8. If you were an animal, when do you think it would be easiest to find food - when the ground is green, brown, or white?

It would be easiest to find food when the ground is green because the temperatures are warmer and more plants are available for a source of food for the food chain.

9. How do you think scientists might use these "green-up" and "brown-down" images to understand how and why animals migrate?

Scientists can study images of seasonal changes as animals migrate, or they can study the length of the growing season, or the amount of plant material produced in a given area over the course of a season or year. This information will help them to understand patterns such as insect outbreaks and other changes that can affect food availability of migrating animals.

10. Look at the black regions at the north and south poles. What do you think causes the black color?

Black suggests that there was not enough sunlight at that time and location to capture an image.

IV. Assessment

Students should be able to make the connection between the color of the Earth (as observed from space) and the season of the Earth at that time and location. They should also be able to explain how the seasons of North America compare to those in other parts of the Earth. Students should be able to recognize from the images that although it might be winter in one location, it could be summer in another. Use the discussion questions presented above to reinforce these points. You may wish to have students write written answers to these questions on the back of their activity sheets. In the [Hawk in Flight](#) lesson, students will use this knowledge to track animals throughout the course of a year using this same series of green-up/brown-down images.

Lesson Extensions for Authentic Assessment

- Some parts of the world never experience cold periods, but leaves turn green and brown as a result of the amount of rainfall. Therefore, in many tropical areas, instead of "spring, summer, fall, winter", it is more appropriate to use terms such as "rainy" or "dry" to describe the seasons. Using several different classroom plants, set up an experiment to water them by varying amounts. Keep a calendar of your watering (or lack of watering) as well as the color changes that the plants undergo, in order to see the connection between water availability and leaf color.
- To explore the connection between plant seed production and leaf color, purchase some wheat seeds at any marketplace to grow. Your class will discover that after a wheat plant produces its seeds, it will turn brown regardless of how much water it receives.
- Using a globe and a flashlight, show in a darkened room how as the Earth changes its tilt, the day length of a location on the rotating globe will change. Which way does the Earth tilt in the summer (Northern hemisphere towards sun)? Which way does it tilt in the winter (opposite way)? How does the day length correspond with the season, and why? (Less sun means lower temperatures.)