My NASA Data - GLOBE Connections

GLOBE Connections: Plant Growth Patterns

This resource helps to identify and access GLOBE protocols and hands-on learning activities that complement the Plant Growth Patterns phenomenon. Students can conduct their own investigations and see how their data related to global patterns by using GLOBE and My NASA Data together.

Visit the **GLOBE Biosphere Protocols & Related ESDE Datasets** page that outlines the datasets available in the Earth System Data Explorer. These data complement student GLOBE investigations using the following protocols.

Plant Growth Patterns

Explore these GLOBE protocols and learning activities to help students develop their understanding of plant growth patterns.

Protocols

GLOBE protocols can be used to collect many types of data to examine plant growth patterns. Students can use the protocols to collect data and share their data with other GLOBE students around the world. As scientists continue their study of plant growth patterns, they can use these data.

Green-up

Grass Green-Up Data Sheet

School Name: _____ Study Site: _____

Observer Names: _____

Plant Scientific Name: Genus _____ Species: _____

Plant Common Name: _____

Green-Up Cycle: ____ Year: _____

Tree and Shrub Green-Up					
Date (day & month)	**Leaf 1** (No shoot length (mm) or lost)	**Leaf 2** (No shoot length (mm) or lost)	**Leaf 3** (No shoot length (mm) or lost)	**Leaf 4** (No shoot length (mm) or lost)	**Data entry** ✓

Check the last column in the green-up table to keep track of data submitted.

Comments *(date each comment):* _____

_____

_____

Source: (GLOBE Website)

Green-up Protocol: Students monitor the budburst and growth of leaves of selected trees, shrubs or grasses. Species chosen should be native, deciduous, and dominant in your area.

Green-down Protocol: Students use a GLOBE Plant Color Guide to monitor the change in color of selected leaves of trees, shrubs or grasses, to help validate estimates of the end of the plant growing season.

The GLOBE Program
www.globe.gov

MUC Field Guide

A Key to Land Cover Classification

Source: (GLOBE Website)

Land Cover Classification: Students locate, photograph, and determine the MUC class for 90 m x 90 m areas of homogeneous land cover.

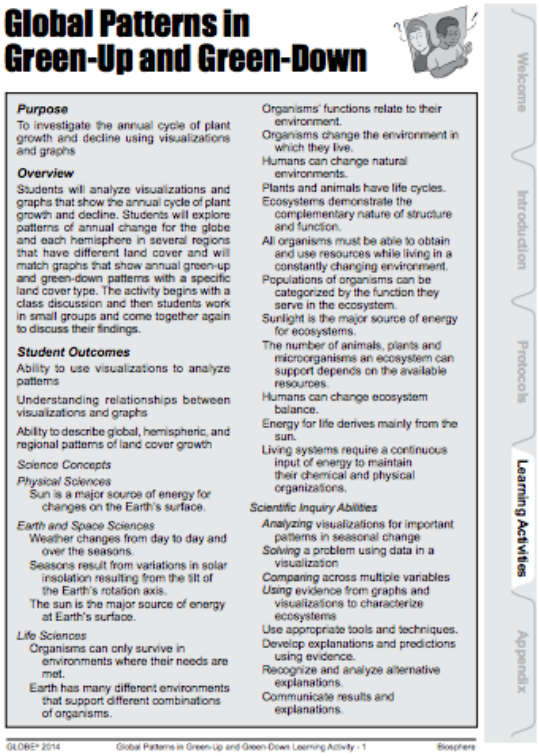
Image Credit: (GLOBE Website)

Lilac Phenology: During the growing season, students observe their lilac plants and identify the five phenophases (first leaf, full or 95% leafed, first bloom, full bloom and end of bloom) for each lilac

plant.

Learning Activities

Check out the three learning activities to help prepare students for collecting data and to support the integration of MND with *GLOBE* in your curriculum.



Global Patterns in Green-Up and Green-Down

Welcome | Introduction | Protocols | Learning Activities | Appendix

Purpose

To investigate the annual cycle of plant growth and decline using visualizations and graphs

Overview

Students will analyze visualizations and graphs that show the annual cycle of plant growth and decline. Students will explore patterns of annual change for the globe and each hemisphere in several regions that have different land cover and will match graphs that show annual green-up and green-down patterns with a specific land cover type. The activity begins with a class discussion and then students work in small groups and come together again to discuss their findings.

Student Outcomes

Ability to use visualizations to analyze patterns

Understanding relationships between visualizations and graphs

Ability to describe global, hemispheric, and regional patterns of land cover growth

Science Concepts

Physical Sciences
- Sun is a major source of energy for changes on the Earth's surface.

Earth and Space Sciences
- Weather changes from day to day and over the seasons.
- Seasons result from variations in solar insolation resulting from the tilt of the Earth's rotation axis.
- The sun is the major source of energy at Earth's surface.

Life Sciences
- Organisms can only survive in environments where their needs are met.
- Earth has many different environments that support different combinations of organisms.
- Organisms' functions relate to their environment.
- Organisms change the environment in which they live.
- Humans can change natural environments.
- Plants and animals have life cycles.
- Ecosystems demonstrate the complementary nature of structure and function.
- All organisms must be able to obtain and use resources while living in a constantly changing environment.
- Populations of organisms can be categorized by the function they serve in the ecosystem.
- Sunlight is the major source of energy for ecosystems.
- The number of animals, plants and microorganisms an ecosystem can support depends on the available resources.
- Humans can change ecosystem balance.
- Energy for life derives mainly from the sun.
- Living systems require a continuous input of energy to maintain their chemical and physical organizations.

Scientific Inquiry Abilities
- *Analyzing* visualizations for important patterns in seasonal change
- *Solving* a problem using data in a visualization
- *Comparing* across multiple variables
- *Using* evidence from graphs and visualizations to characterize ecosystems
- Use appropriate tools and techniques.
- Develop explanations and predictions using evidence.
- Recognize and analyze alternative explanations.
- Communicate results and explanations.

GLOBE® 2014 Global Patterns in Green-Up and Green-Down Learning Activity - 1 Biosphere

Source: (GLOBE Website)

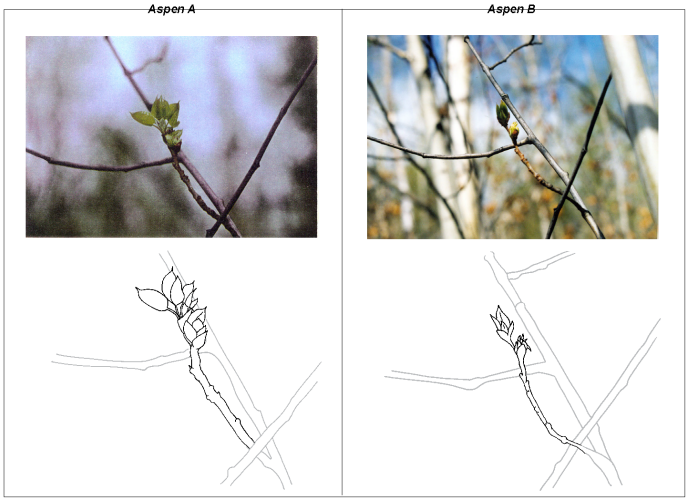
Global Patterns in Green-up and Green-down

Overview: Students analyze visualizations and graphs that show the annual cycle of plant growth

and decline. Students will explore patterns of annual change for the globe and each hemisphere in several regions that have different land cover and will match graphs that show annual green-up and green-down patterns with a specific land cover type. The activity begins with a class discussion and then students work in small groups and come together again to discuss their findings.

Student Outcomes:

- Ability to use visualizations to analyze patterns
- Understanding relationships between visualizations and graphs
- Ability to describe global, hemispheric, and regional patterns of land cover growth



Source: (GLOBE Website)

Green-up Cards

Overview: This activity is to prepare students to recognize what a bud looks like and the progression of green-up from the time of budburst. Students arrange plant growth pictures taken from the bud, shrub canopy, grass clump, landscape, and regional perspectives.

Student Outcomes:
Students recognize temporal (over time) progression of green-up at the bud, shrub canopy, grass clump, landscape, and regional spatial scales.

A First Look At Phenology

Purpose
To increase students' awareness of qualitative changes in plant(s) during green-up and green-down from which they will be collecting quantitative leaf change data

To develop an understanding of the patterns, similarities, and differences among plants at the same location

Overview
Students will observe, compare, and classify plants during green-up or green-down and then make inferences based on the patterns they observe.

Student Outcomes
Students will learn stated science concepts and be able to apply process skills in understanding patterns of green-up and green-down among plants.

Science Concepts
Life Sciences
Earth has many different environments that support different combinations of organisms.
Organisms' functions relate to their environment.
Plants and animals have life cycles.

Scientific Inquiry Abilities
Observing
Measuring
Classifying
Collecting data
Analyzing data
Inferring
Predicting
Use appropriate tools and techniques.
Develop explanations and predictions using evidence.
Recognize and analyze alternative explanations.

Time
Two to three class periods

Level
Beginning and Intermediate

Materials
Hand lens
Survey tape
Pencils
GLOBE Science Log
Plants
Charts

Prerequisites
None

Background
Phenology is the study of organisms' response to seasonal and climatic changes in their environment. Seasonal changes include variations in day length or duration of sunlight, precipitation, temperature and other life-controlling factors. The focus of this activity is plant phenology during green-up and green-down also called senescence. Green-up and green-down can be used to examine regional and global vegetation patterns, year to year variations, and vegetation responses to climate change.

For deciduous trees, bushes, and shrubs the growing season can be defined by the appearance of leaves in the spring and the dropping of leaves in the fall. Plant green-up is initiated when dormancy (a state of suspended growth and metabolism) ceases due to environmental conditions such as longer hours of sunlight, higher temperatures, and increased availability of water. This happens during spring for plants in temperate climates. Plant roots begin absorbing water and nutrients from the soil, and transport these to other parts within the plant including buds or shoots. Growth-inhibiting substances are broken down and replaced by growth-promoting substances. Plant leaves start to

GLOBE® 2014 First Look at Phenology Learning Activity - 1 Biosphere

Welcome | Introduction | Protocols | Learning Activities | Appendix

Source: (GLOBE Website)

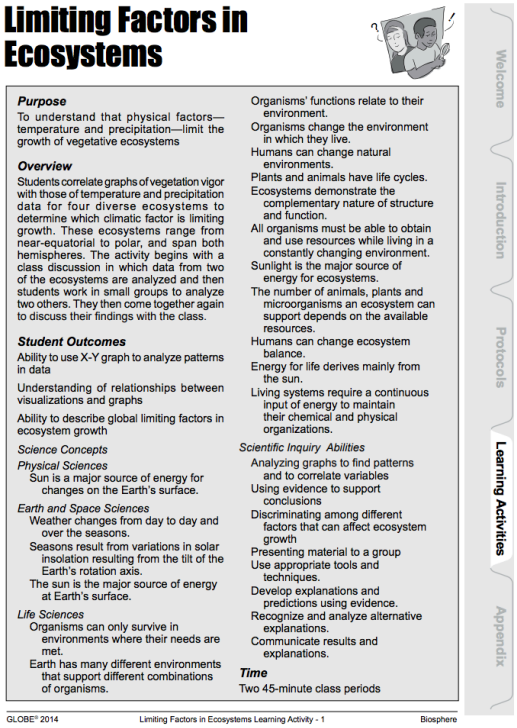
First Look at Phenology

Overview: Students observe, compare, and classify plants during green-up or green-down, making

inferences based on the patterns they observe. During the investigation students' increase their awareness of qualitative changes in plant(s) during green-up and green down from which they will be collecting quantitative leaf change data.

Student Outcomes:

- Students learn stated science concepts and be able to apply process skills in understanding patterns of green-up and green-down among plants.



Limiting Factors in Ecosystems

Welcome | Introduction | Protocols | Learning Activities | Appendix

Purpose
To understand that physical factors—temperature and precipitation—limit the growth of vegetative ecosystems

Overview
Students correlate graphs of vegetation vigor with those of temperature and precipitation data for four diverse ecosystems to determine which climatic factor is limiting growth. These ecosystems range from near-equatorial to polar, and span both hemispheres. The activity begins with a class discussion in which data from two of the ecosystems are analyzed and then students work in small groups to analyze two others. They then come together again to discuss their findings with the class.

Student Outcomes
Ability to use X-Y graph to analyze patterns in data
Understanding of relationships between visualizations and graphs
Ability to describe global limiting factors in ecosystem growth

Science Concepts
Physical Sciences
Sun is a major source of energy for changes on the Earth's surface.
Earth and Space Sciences
Weather changes from day to day and over the seasons.
Seasons result from variations in solar insolation resulting from the tilt of the Earth's rotation axis.
The sun is the major source of energy at Earth's surface.
Life Sciences
Organisms can only survive in environments where their needs are met.
Earth has many different environments that support different combinations of organisms.
Organisms' functions relate to their environment.
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Humans can change natural environments.
Plants and animals have life cycles.
Ecosystems demonstrate the complementary nature of structure and function.
All organisms must be able to obtain and use resources while living in a constantly changing environment.
Sunlight is the major source of energy for ecosystems.
The number of animals, plants and microorganisms an ecosystem can support depends on the available resources.
Humans can change ecosystem balance.
Energy for life derives mainly from the sun.
Living systems require a continuous input of energy to maintain their chemical and physical organizations.

Scientific Inquiry Abilities
Analyzing graphs to find patterns and to correlate variables
Using evidence to support conclusions
Discriminating among different factors that can affect ecosystem growth
Presenting material to a group
Use appropriate tools and techniques.
Develop explanations and predictions using evidence.
Recognize and analyze alternative explanations.
Communicate results and explanations.

Time
Two 45-minute class periods

GLOBE® 2014 Limiting Factors in Ecosystems Learning Activity - 1 Biosphere

Source: (GLOBE Website)

Limiting Factors in Ecosystems

Overview: Students correlate graphs of vegetation vigor with those of temperature and precipitation data for four diverse ecosystems to determine which climatic factor is limiting growth. These ecosystems range from near-equatorial to polar and span both hemispheres. The activity begins with a class discussion in which data from two of the ecosystems are analyzed and then students work in small groups to analyze two others. They then come together again to discuss their findings with the class.

Student Outcomes:

- Ability to use X-Y graph to analyze patterns in data
- Understanding of relationships between visualizations and graphs
- Ability to describe global limiting factors in ecosystem growth