
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.

Grass Green-Up Data Sheet

School Name: _____ Study Site: _____

Observer Names: _____

Plant Scientific Name: Genus _____ Species: _____

Plant Common Name: _____

Green-Up Cycle: Year:

[illegible]

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.

MUC Field Guide

A Key to Land Cover Classification

Source: ([GLOBE Website](http://www.globe.gov))

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



Purpose To investigate the annual cycle of plant growth and decline using visualizations and graphs	Organisms' functions relate to their environment. Organisms change the environment in which they live. Humans can change natural environments.
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.	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.
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	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.
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.	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.
Life Sciences Organisms can only survive in environments where their needs are met. Earth has many different environments that support different combinations of organisms.	

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

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[Source: \(GLOBE Website\)](#)



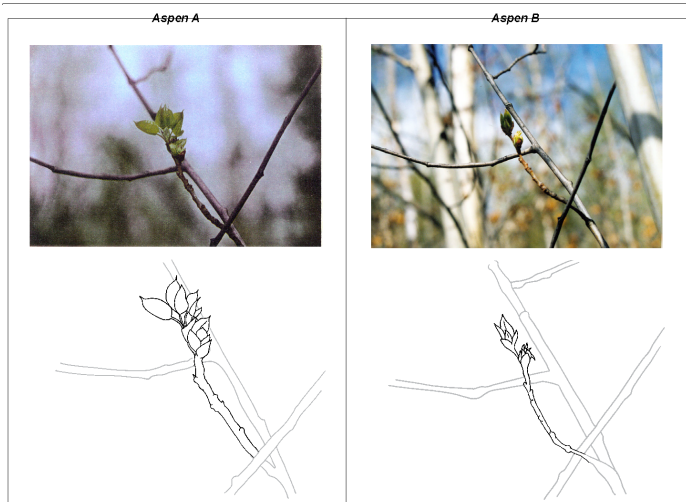
[Global Patterns in Green-up and Green-down](#)

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
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Background
Phenology is the study of organisms' response to seasonal and climate 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

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

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



Purpose To understand that physical factors—temperature and precipitation—limit the growth of vegetative ecosystems	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. 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.
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.	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.
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	Time Two 45-minute class periods
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.	

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

