## **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 <u>GLOBE Biosphere Protocols & Related ESDE Datasets</u> 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.

bserver I	Names:				
lant Scier	ntific Name: Genu	S	Species:		
lant Com	mon Name:				
reen-Up	Cycle: Year				
		ree and Chru	h Green Un		
Date Leaf 1 Leaf 2 Leaf 3 Leaf 4 Date					
(day & month)	(No shoot length (mm) or lost)	entry √			

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)

**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.

reen-Up and Gre	en-Down 🏼
turpose to investigate the annual cycle of plant rowth and decline using visualizations nd graphs	Organisms' functions relate to their environment. Organisms change the environment in which they live.
Dverview	Humans can change natural environments
Subjects will analyze visualizations and impach that show the annual cycle of plant intervals and decline. Students will explore subterns of annual charge for the globe subterns of annual charge for the globe match and the student land course regive intach graphs that show annual graen-up and green-down patterns with a specific and green year patterns with a specific and groups and come together again a 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 linking in a opulation of the structure application of the structure participation of the structure serve in the occeptance. Surlight is the major source of energy for anonsetime.
Student Outcomes	The number of animals, plants and
atterns of concornes of analyze	microorganisms an ecosystem can support depends on the available resources.
Inderstanding relationships between isualizations and graphs	Humans can change ecosystem balance.
bility to describe global, hemispheric, and egional patterns of land cover growth	Energy for life derives mainly from the sun. Living systems require a continuous
cience Concepts	input of energy to maintain
Physical Sciences Sun is a major source of energy for charges on the Earth's surface	organizations.
Changes on the Earth's surface. Earth and Space Sciences Weather changes from day to day and	Analyzing visualizations for important patterns in seasonal change Scholars a scholar wine dange
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.	Visualization Comparing across multiple variables Using evidence from graphs and visualizations to characterize ecosystemis
We Sciences Organisms can only survive in environments where their needs are met.	Use appropriate tools and techniques. Develop explanations and predictions using evidence. Recognize and analyze alternative
Earth has many different environments that support different combinations of organisms.	explanations. Communicate results and explanations.

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)



**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.



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.

urposo	Organisms' functions relate to their	9
o understand that physical factors-	environment.	0
emperature and precipitation-limit the rowth of vegetative ecosystems	Organisms change the environment in which they live.	
Wandow	Humans can change natural environments	
tudents correlate graphs of vegetation vigor	Plants and animals have life cycles.	
ith those of temperature and precipitation ata for four diverse ecosystems to	Ecosystems demonstrate the complementary nature of structure and function.	
rowth. These ecosystems range from ear-equatorial to polar, and span both	All organisms must be able to obtain and use resources while living in a	
emispheres. The activity begins with a lass discussion in which data from two f the ecosystems are analyzed and then	Sunlight is the major source of energy for ecosystems.	
tudents work in small groups to analyze wo others. They then come together again o discuss their findings with the class.	The number of animals, plants and microorganisms an ecosystem can support depends on the available resources.	<
tudent Outcomes	Humans can change ecosystem	
bility to use X-Y graph to analyze patterns data	balance. Energy for life derives mainly from the sun.	
Inderstanding of relationships between isualizations and graphs	Living systems require a continuous input of energy to maintain the is described advantaged	0
cosystem growth	organizations.	
cience Concepts	Scientific Inquiry Abilities	Ę.
hysical Sciences Sun is a major source of energy for changes on the Earth's surface.	Analyzing graphs to find patterns and to correlate variables Using evidence to support	1
arth and Space Sciences Weather changes from day to day and	conclusions Discriminating among different factors that can affect ecosystem	
Seasons result from variations in solar	growth	
insolation resulting from the tilt of the Earth's rotation axis.	Use appropriate tools and techniques.	<
at Earth's surface.	Develop explanations and	
ife Sciences Organisms can only survive in	Recognize and analyze alternative explanations.	- date
environments where their needs are met.	Communicate results and explanations.	
that support different combinations	Time	,



**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.

Source: (GLOBE Website)

### **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