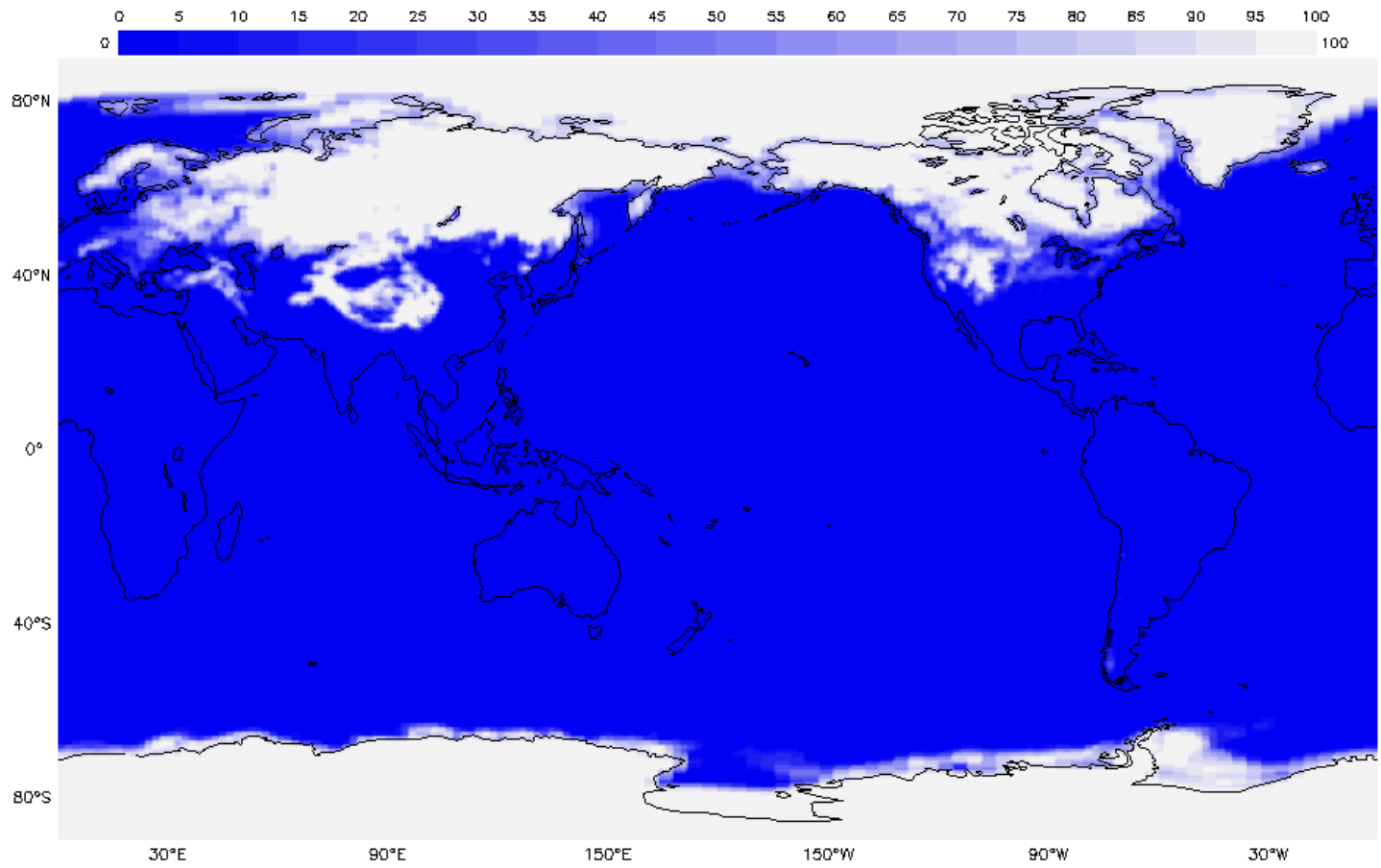
My NASA Data - GLOBE Connections

GLOBE Connections: Changes in Snow and Ice Extent



GLOBE protocols and learning activities that complement the Changes in Snow and Ice Extent phenomenon through hands-on investigations are detailed below. 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 Cryosphere 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.

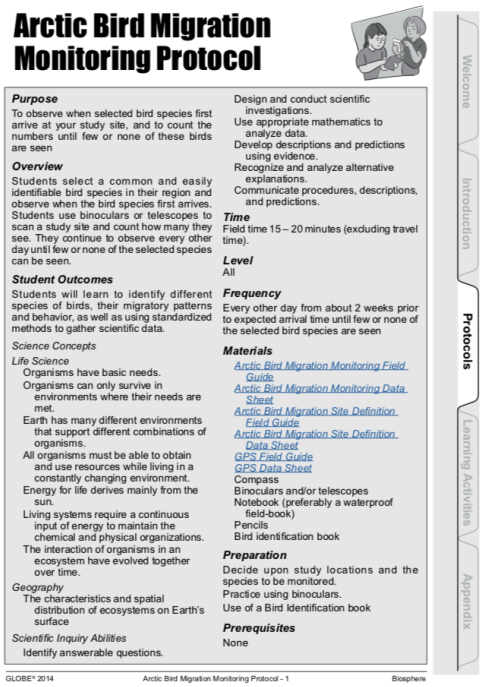
Changes in Snow and Ice Extent

Ice, which covers 10 percent of Earth's surface, is disappearing rapidly. While the Arctic sea ice extent is declining, air temperatures are rising. Vegetation is changing, with tundra being replaced by shrubs. Permafrost is warming and thawing over parts of the Arctic.

Students can use GLOBE protocols to study changing temperatures, permafrost and fresh water ice.

Protocols

GLOBE protocols can be used to collect many types of data to explore the conditions related to formation and melt of sea and land ice. Students can use the protocols to collect data and share their data with other GLOBE students around the world.



Arctic Bird Migration Monitoring Protocol

Purpose
To observe when selected bird species first arrive at your study site, and to count the numbers until few or none of these birds are seen

Overview
Students select a common and easily identifiable bird species in their region and observe when the bird species first arrives. Students use binoculars or telescopes to scan a study site and count how many they see. They continue to observe every other day until few or none of the selected species can be seen.

Student Outcomes
Students will learn to identify different species of birds, their migratory patterns and behavior, as well as using standardized methods to gather scientific data.

Science Concepts

Life Science
- Organisms have basic needs.
- Organisms can only survive in environments where their needs are met.
- Earth has many different environments that support different combinations of organisms.
- All organisms must be able to obtain and use resources while living in a constantly changing environment.
- Energy for life derives mainly from the sun.
- Living systems require a continuous input of energy to maintain the chemical and physical organizations.
- The interaction of organisms in an ecosystem have evolved together over time.

Geography
- The characteristics and spatial distribution of ecosystems on Earth's surface

Scientific Inquiry Abilities
- Identify answerable questions.
- Design and conduct scientific investigations.
- Use appropriate mathematics to analyze data.
- Develop descriptions and predictions using evidence.
- Recognize and analyze alternative explanations.
- Communicate procedures, descriptions, and predictions.

Time
Field time 15 – 20 minutes (excluding travel time).

Level
All

Frequency
Every other day from about 2 weeks prior to expected arrival time until few or none of the selected bird species are seen

Materials
- Arctic Bird Migration Monitoring Field Guide
- Arctic Bird Migration Monitoring Data Sheet
- Arctic Bird Migration Site Definition Field Guide
- Arctic Bird Migration Site Definition Data Sheet
- GPS Field Guide
- GPS Data Sheet
- Compass
- Binoculars and/or telescopes
- Notebook (preferably a waterproof field-book)
- Pencils
- Bird identification book

Preparation
Decide upon study locations and the species to be monitored.
Practice using binoculars.
Use of a Bird Identification book

Prerequisites
None

GLOBE® 2014 Arctic Bird Migration Monitoring Protocol - 1 Biosphere

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Arctic Bird Migration: Over the year, students observe when specified migratory bird species first arrive and count their numbers until few or none of them remain.

Student Outcomes:

- Students will learn to identify different species of birds, their migratory patterns and behavior, as well as using standardized methods to gather scientific data

Source: GLOBE Website

Freshwater Ice Phenology

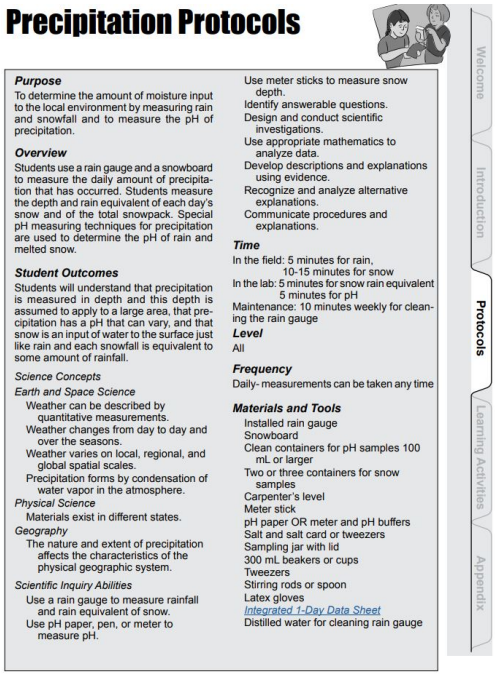
The purpose of the Freshwater Ice Phenology Protocol is to monitor the freeze-up and breakup processes on a selected pond/lake or large creek/river to determine the duration of the annual ice cover. Students will select an easily accessible pond/lake or large creek/river close to their school

that is known to develop an ice cover in the winter and observe and document its freeze-up and break-up.

Frost Tube: Students will construct a Frost Tube that is inserted into a hole in an undisturbed and un-compacted soil. During the cold months, students will measure the depth at which water in the Frost Tube freezes, indicating that the surrounding soil has frozen.

Student Outcomes:

- Observe when water in the Frost Tube freezes
- Collect and analyze data related to freezing of soil to understand how soil temperature and moisture coincide with changes in seasons across different biomes
- Examine relationships among air, soil and permafrost
- Communicate project results with other GLOBE schools
- Collaborate with other GLOBE schools (within your country or other countries)
- Share observations by submitting data to the GLOBE archive
- Compare the timing and depth of freezing in soils in different regions around the world
- Predict the timing and depth of freezing for upcoming seasons (advanced)



Precipitation Protocols

Welcome | Introduction | **Protocols** | Learning Activities | Appendix

Purpose
To determine the amount of moisture input to the local environment by measuring rain and snowfall and to measure the pH of precipitation.

Overview
Students use a rain gauge and a snowboard to measure the daily amount of precipitation that has occurred. Students measure the depth and rain equivalent of each day's snow and of the total snowpack. Special pH measuring techniques for precipitation are used to determine the pH of rain and melted snow.

Student Outcomes
Students will understand that precipitation is measured in depth and this depth is assumed to apply to a large area, that precipitation has a pH that can vary, and that snow is an input of water to the surface just like rain and each snowfall is equivalent to some amount of rainfall.

Science Concepts
Earth and Space Science
- Weather can be described by quantitative measurements.
- Weather changes from day to day and over the seasons.
- Weather varies on local, regional, and global spatial scales.
- Precipitation forms by condensation of water vapor in the atmosphere.

Physical Science
- Materials exist in different states.

Geography
- The nature and extent of precipitation affects the characteristics of the physical geographic system.

Scientific Inquiry Abilities
- Use a rain gauge to measure rainfall and rain equivalent of snow.
- Use pH paper, pen, or meter to measure pH.
- Use meter sticks to measure snow depth.
- Identify answerable questions.
- Design and conduct scientific investigations.
- Use appropriate mathematics to analyze data.
- Develop descriptions and explanations using evidence.
- Recognize and analyze alternative explanations.
- Communicate procedures and explanations.

Time
In the field: 5 minutes for rain, 10-15 minutes for snow
In the lab: 5 minutes for snow rain equivalent, 5 minutes for pH
Maintenance: 10 minutes weekly for cleaning the rain gauge

Level
All

Frequency
Daily- measurements can be taken any time

Materials and Tools
- Installed rain gauge
- Snowboard
- Clean containers for pH samples 100 mL or larger
- Two or three containers for snow samples
- Carpenter's level
- Meter stick
- pH paper OR meter and pH buffers
- Salt and salt card or tweezers
- Sampling jar with lid
- 300 mL beakers or cups
- Tweezers
- Stirring rods or spoon
- Latex gloves
- *Integrated 1-Day Data Sheet*
- Distilled water for cleaning rain gauge

Source: GLOBE Website

Precipitation

Students use a rain gauge and a snowboard to measure the daily amount of precipitation that has occurred. Students measure the depth and rain equivalent of each day's snow and of the total snowpack. Special pH measuring techniques for precipitation are used to determine the pH of rain and melted snow.

Student Outcomes:

- Students will understand that precipitation is measured in depth and this depth is assumed to apply to a large area, that precipitation has a pH that can vary, and that snow is an input of

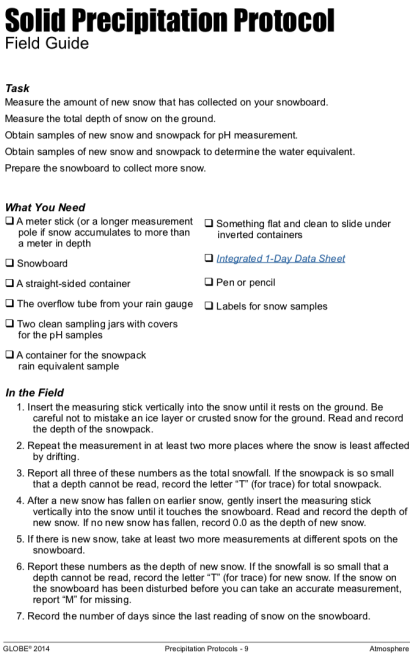
water to the surface just like rain and each snowfall is equivalent to some amount of rainfall

Snowboard Construction: A snowboard is a thin, flat surface that rests on top of earlier layers of snow. New snow falls on top of it and can be measured with a meter stick.

Student Outcomes:

- Prepare the snowboard to collect more snow

Solid Precipitation: Students will measure the amount of new snow that has collected on your snowboard in comparison with the total depth of snow on the ground.



Solid Precipitation Protocol
Field Guide

Task
Measure the amount of new snow that has collected on your snowboard.
Measure the total depth of snow on the ground.
Obtain samples of new snow and snowpack for pH measurement.
Obtain samples of new snow and snowpack to determine the water equivalent.
Prepare the snowboard to collect more snow.

What You Need
- ❑ A meter stick (or a longer measurement pole if snow accumulates to more than a meter in depth
- ❑ Snowboard
- ❑ A straight-sided container
- ❑ The overflow tube from your rain gauge
- ❑ Two clean sampling jars with covers for the pH samples
- ❑ A container for the snowpack rain equivalent sample
- ❑ Something flat and clean to slide under inverted containers
- ❑ *Integrated 1-Day Data Sheet*
- ❑ Pen or pencil
- ❑ Labels for snow samples

In the Field
1. Insert the measuring stick vertically into the snow until it rests on the ground. Be careful not to mistake an ice layer or crusted snow for the ground. Read and record the depth of the snowpack.
2. Repeat the measurement in at least two more places where the snow is least affected by drifting.
3. Report all three of these numbers as the total snowfall. If the snowpack is so small that a depth cannot be read, record the letter "T" (for trace) for total snowpack.
4. After a new snow has fallen on earlier snow, gently insert the measuring stick vertically into the snow until it touches the snowboard. Read and record the depth of new snow. If no new snow has fallen, record 0.0 as the depth of new snow.
5. If there is new snow, take at least two more measurements at different spots on the snowboard.
6. Report these numbers as the depth of new snow. If the snowfall is so small that a depth cannot be read, record the letter "T" (for trace) for new snow. If the snow on the snowboard has been disturbed before you can take an accurate measurement, report "M" for missing.
7. Record the number of days since the last reading of snow on the snowboard.

GLOBE® 2014 Precipitation Protocols - 9 Atmosphere

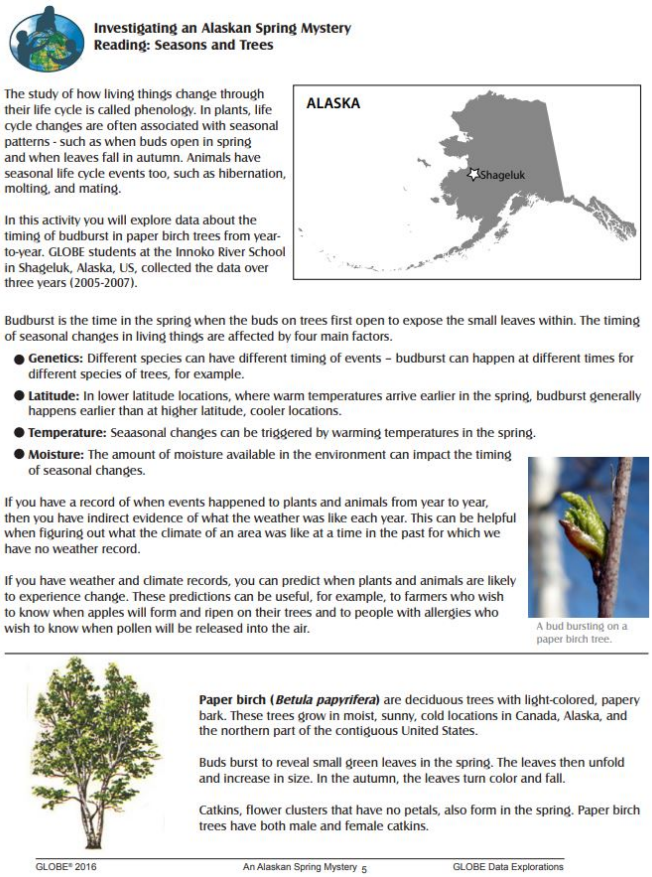
Student Outcomes:

- Students will measure the amount of new snow that has collected on your snowboard
- Students will measure the total depth of snow on the ground
- Students will obtain samples of new snow and snowpack for pH measurement
- Students will obtain samples of new snow and snowpack to determine the water equivalent
- Prepare the snowboard to collect more snow

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.

An Alaskan Spring Mystery



Investigating an Alaskan Spring Mystery
Reading: Seasons and Trees

The study of how living things change through their life cycle is called phenology. In plants, life cycle changes are often associated with seasonal patterns - such as when buds open in spring and when leaves fall in autumn. Animals have seasonal life cycle events too, such as hibernation, molting, and mating.

In this activity you will explore data about the timing of budburst in paper birch trees from year-to-year. GLOBE students at the Innoko River School in Shageluk, Alaska, US, collected the data over three years (2005-2007).

Budburst is the time in the spring when the buds on trees first open to expose the small leaves within. The timing of seasonal changes in living things are affected by four main factors.

- **Genetics:** Different species can have different timing of events – budburst can happen at different times for different species of trees, for example.
- **Latitude:** In lower latitude locations, where warm temperatures arrive earlier in the spring, budburst generally happens earlier than at higher latitude, cooler locations.
- **Temperature:** Seaasonal changes can be triggered by warming temperatures in the spring.
- **Moisture:** The amount of moisture available in the environment can impact the timing of seasonal changes.

If you have a record of when events happened to plants and animals from year to year, then you have indirect evidence of what the weather was like each year. This can be helpful when figuring out what the climate of an area was like at a time in the past for which we have no weather record.

If you have weather and climate records, you can predict when plants and animals are likely to experience change. These predictions can be useful, for example, to farmers who wish to know when apples will form and ripen on their trees and to people with allergies who wish to know when pollen will be released into the air.

A bud bursting on a paper birch tree.

Paper birch (*Betula papyrifera*) are deciduous trees with light-colored, papery bark. These trees grow in moist, sunny, cold locations in Canada, Alaska, and the northern part of the contiguous United States.

Buds burst to reveal small green leaves in the spring. The leaves then unfold and increase in size. In the autumn, the leaves turn color and fall.

Catkins, flower clusters that have no petals, also form in the spring. Paper birch trees have both male and female catkins.

In the GLOBE Learning Activity**,** *An Alaskan Spring Mystery: A GLOBE Data Exploration***,** students analyze data about the timing of budburst for a tree species over three years in the same location. They investigate two different hypotheses for why timing differs by analyzing weather data from the same time period.

Student Outcomes:

• Analyze different types of data (phenology, temperature, rainfall)
• Form hypotheses based on their analysis of a dataset
• Test hypotheses with environmental data
• Come to a conclusion about the impacts of environmental factors on budburst and explain their reasoning

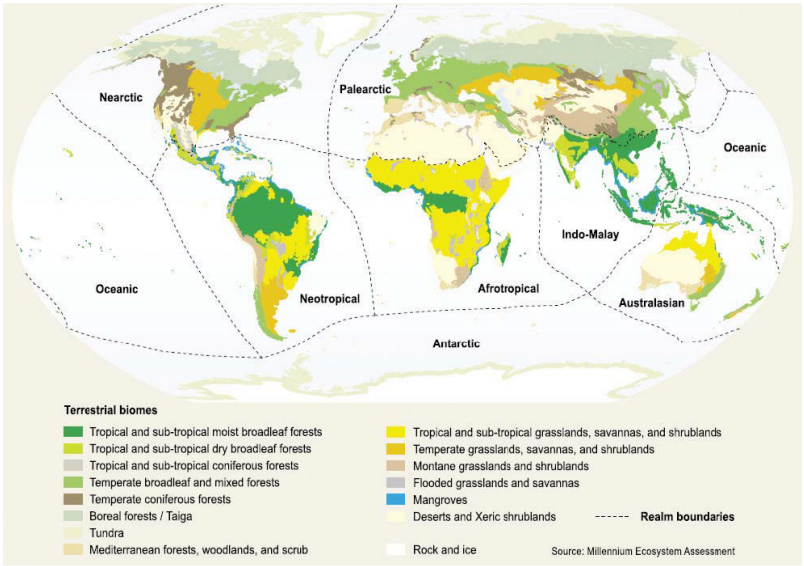


Figure 1. The global distribution of the eight biogeographic realms and the 14 major biomes. Original source for Map: D.M. Olson et al. 2001

Source: [GLOBE Getting to Know Your

[Terrestrial Biomes]

Getting to Know Your Terrestrial Biomes 

Help students become familiar with the Terrestrial Biome Classifications that the Seasons and Biomes project has adopted. Changes in snow and ice extent contribute to biome classification.

Student Outcomes:

- Use appropriate sources of information
- Synthesize data from different sources to create a coherent description of the main biomes
- Identify appropriate sources of information
- Organize data into tables
- Draw conclusions by synthesizing a variety of data
- Communicate results and explanations

How to Make a Climograph from Your Local Weather Data 

Purpose: Students will assemble, analyze and graph the long-term air temperature and precipitation data for their general area, to understand the difference between weather and climate. These data can include snow and ice.

Student Outcomes:

- Weather is a day-to-day phenomenon and climate is a long-term average of weather
- The sun is the major source of energy for changes on the Earth's surface
- Organisms' functions relate to their environment
- Sunlight is the major source of energy for ecosystems
- Identify appropriate data sources
- Perform simple statistical calculations
- Organize data into tables and graphs
- Use appropriate tools and techniques
- Draw conclusions by synthesizing a variety of data
- Communicate results and explanations

Sources:

GLOBE Website