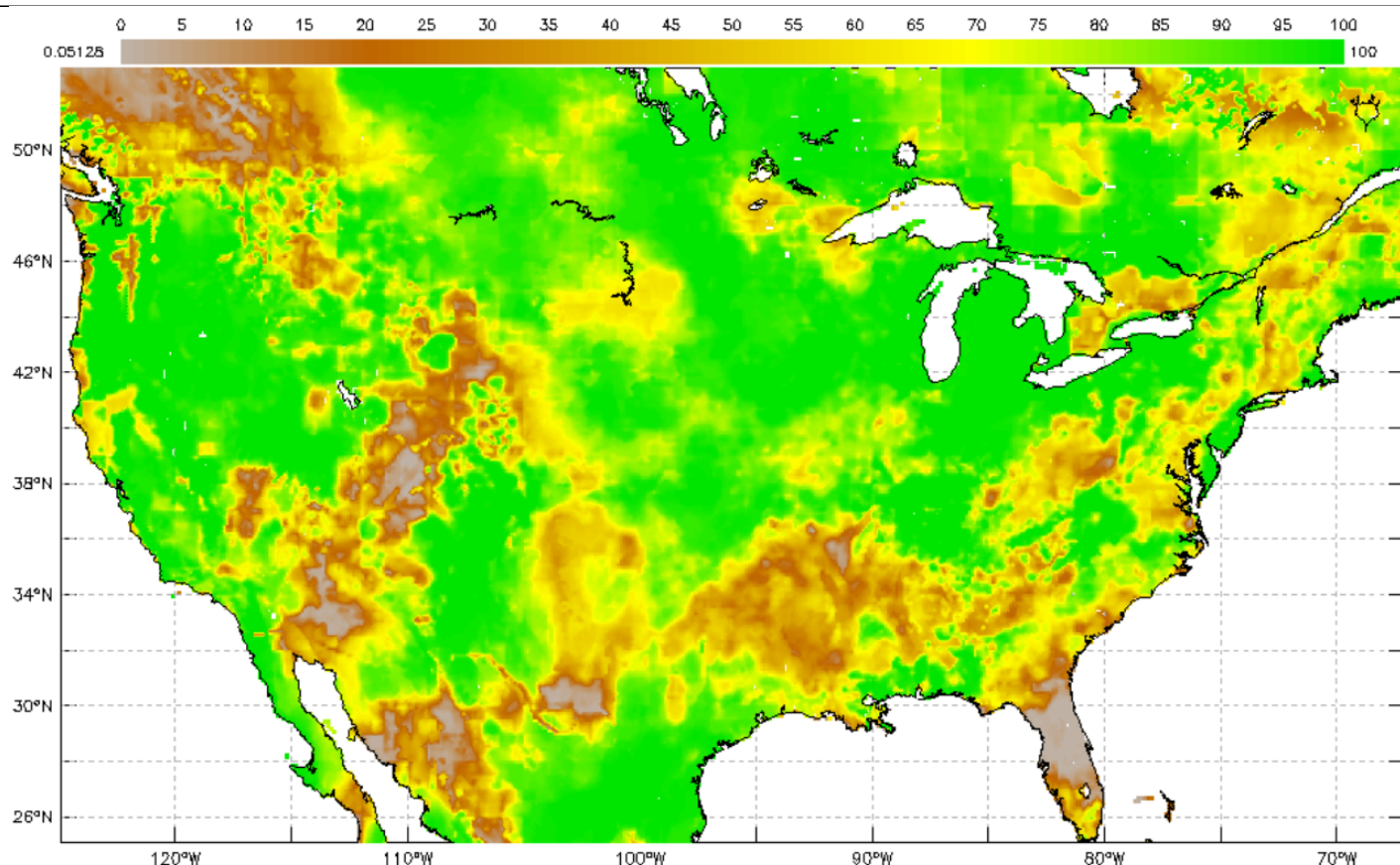

My NASA Data - GLOBE Connections

GLOBE Connections: Soil Moisture



GLOBE protocols and learning activities that complement the Deforestation 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 Geosphere 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.

[Soil Moisture](#)

Protocols

GLOBE protocols can be used to collect many types of data to examine tree cover and deforestation. 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 deforestation, they can use these data.

Soil Infiltration

Students will use a dual ring infiltrometer that they can construct from large food container cans to measure the rate at which water soaks into the soil during a roughly 45-minute period.

Soil Moisture

There are several GLOBE protocols for soil moisture. This gives students more than one way to determine soil moisture.

- **Gravimetric:** Students will measure soil water content by comparing the wet and dry masses of samples.
- **SMAP Block Pattern:** Students will obtain in situ measurements of soil moisture that are consistent with soil moisture measurements from the Soil Moisture Active Passive (SMAP) satellite.
- **Sensors:** Students will develop a calibration curve and use it to determine soil water content at depths of 10 cm, 30 cm, 60 cm, and 90 cm from meter readings of four soil moisture sensor blocks.

Protocol Bundles

These protocol bundles are related to soil moisture.

1. [ENSO Protocol Bundle](#) - This bundle includes atmosphere, hydrosphere, and pedosphere protocols that are used for the GLOBE ENSO (El Niño Southern Oscillation) Campaign which has been formulated to engage students in determining where and how much El Niño affects local places and to put students in contact with the resulting patterns in their local environment.
2. [Rivers and Lakes Protocol Bundle](#) - The purpose of the Rivers and Lakes Protocol Bundle is to group GLOBE protocols that may provide students with the knowledge and ideas of various interactions happening in their local rivers and lakes.
3. [Soil Protocol Bundle](#) - The purpose of the Soil Bundle protocol is to provide greater knowledge on the relationship between soil characteristics and their function for different ecosystems.
4. [Water Cycle Protocol Bundle](#) - The Water Cycle is a key part of the Earth system. The fluxes and reservoirs that comprise it vary over time and space. The data you collect can help characterize the cycle in your area. This bundle contains atmosphere, hydrosphere, and pedosphere protocols.
5. [Water Quality Protocol Bundle](#) - As water interacts with the atmosphere, soil and the surrounding land cover bordering water bodies, and the surface over which the water flows, the water quality changes. Water quality determines what can live in the water body and how the water may be used. This bundle contains atmosphere, hydrosphere, and pedosphere protocols.

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. These activities will provide students with a hands-on experience to guide their understanding of the properties of soil that affect the amount of moisture it will hold.

Soils as Sponges: How Much Water Does Soil Hold?



Purpose To introduce students to gravimetric measurements of water content through calculating the amount of water in sponge and soil samples by weighing the samples before and after drying.	Scientific Inquiry Abilities Identify answerable questions. Design and conduct an investigation. Use appropriate tools and techniques including mathematics to gather, analyze, and interpret data. Develop descriptions and explanations, predictions and models using evidence. Communicate procedures and explanations.
Overview Students determine the moisture content of a sponge after squeezing the water out of the sponge, and allowing water to evaporate from the sponge. Students also measure the amount of water that has evaporated from the soil samples.	Time Approximately two class periods for the initial sponge and soil activities; then 10-15 minutes per day for about 3 days, as objects dry
Student Outcomes Students will understand that objects can hold a measurable amount of water. Students will be able to transfer this concept to soil by weighing wet and dry soil samples and calculating the amount of water held by the soil.	Level Middle and Secondary
Science Concepts Earth and Space Science Earth materials are solid rocks, soil, water, biota, and the gases of the atmosphere. Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants. The surface of Earth changes. Soils are often found in layers, with each having a different chemical composition and texture. Soils consist of minerals (less than 2 mm), organic material, air and water. Water circulates through soil changing the properties of both the soil and the water.	Materials and Tools Scale or balance Several sponges with different properties (e.g. size, shape, thickness, pore size and number of pores) Soil samples Paper towels, paper plates, newspaper, or other surface to dry soils on Tray to place wet sponges and soils on Graph paper (for intermediate or advanced)
	Prerequisites Knowledge of fractions, decimals, and simple algebra

Welcome

Introduction

Protocols

Learning Activities

Appendix

Source: [GLOBE Website](#)

Soils as Sponges: How Much Water Does Soil Hold?

Overview: Students determine the moisture content of a sponge after squeezing the water out of the sponge, and allowing water to evaporate from the sponge. Students also measure the amount of water that has evaporated from the soil samples.

Student Outcomes:

- Students will understand that objects can hold a measurable amount of water.
- Students will be able to transfer this concept to soil by weighing wet and dry soil samples and calculating the amount of water held by the soil.

Just Passing Through



Welcome

Introduction

Protocols

Learning Activities

Appendix

Purpose

To develop an understanding of some of the relationships between soils of different types and water

Overview

Students will time the flow of water through soils with different properties and measure the amount of water held in these soils. They will also experiment with the filtering ability of soils by testing the pH of the water before and after it passes through the soil and observing changes to the clarity of the water and to the characteristics of the soil.

Student Outcomes

Students will be able to identify the physical and chemical changes that occur as water passes through soil. Students will be able to design experiments that test soil and water properties. Students will be able to explore the concept of Earth as a system. Students will be able to apply the Scientific Method.

Science Concepts

Earth and Space Science

Earth materials are solid rocks, soil, water, biota, and the gases of the atmosphere.

Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants.

The surface of Earth changes.

Soils consist of minerals (less than 2 mm), organic material, air and water.

Water circulates through soil changing the properties of both the soil and the water.

Scientific Inquiry Abilities

Identify answerable questions.

Design and conduct an investigation.

Use appropriate tools and techniques including mathematics to gather, analyze, and interpret data.

Develop descriptions and

explanations, predictions and models using evidence. Communicate procedures and explanations.

Time

One class period for initial activity

2-3 class periods for Further Investigations

Level

All

Materials and Tools

(for each team of 3 - 4 students)

2 - 3 clear 2-liter bottles (such as soda or water comes in)*

4 - 6 500-ml. beakers* or similar size clear containers to pour and catch water for the demonstration, more as needed for the class activity.

The number of beakers will be dependent on the number of student groups. (Clear plastic bottles work well also.)

Soil samples (Bring in 1.2 L samples of different types of soil from around the school or from home (suggested amount - actual amount based on class size). A large plastic bag with a closeable top is a good way to transport soil samples. Possibilities include topsoil (A horizons), subsoils (B horizons), potting soil, sand, soils that are compacted, soils with grass or other plants growing on top, soils with distinctly different colors, textures, or structures, or cat litter (without additives).

Fine window screen or other fine mesh such as panty hose that does not absorb or react with water (1 mm or less mesh size)

Strong tape or rubber bands

Scissors

Water

Laboratory ring stands with rings, if available (enough to hold the number of plastic bottles to be used). Another approach is to rest

GLOBE® 2014

Just Passing Through Learning Activity - 1

Soil (Pedosphere)

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

Just Passing Through

Overview: Students will time the flow of water through soils with different properties and measure the amount of water held in these soils. They will also experiment with the filtering ability of soils by testing the pH of the water before and after it passes through the soil and observing changes to the clarity of the water and to the characteristics of the soil.

Student Outcomes:

- Students will be able to identify the physical and chemical changes that occur as water passes through the soil.
- Students will be able to design experiments that test soil and water properties. Students will be able to explore the concept of Earth as a system.
- Students will be able to apply the Scientific Research Process

Just Passing Through (Beginner Version)



Welcome

Introduction

Protocols

Learning Activities

Appendix

Purpose

To develop an understanding of how water flows through different soils and how it is transformed when it flows through these soils

Overview

Students time the flow of water through different soils and observe the amount of water held in these soils. They will also observe the filtering ability of soils by noting the clarity of the water before and after it passes through the soil.

Student Outcomes

Students will be able to identify the physical and chemical changes that occur as water passes through soil.

Science Concepts

Earth and Space Science

Earth materials are solid rocks, soil, water, biota, and the gases of the atmosphere.

Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants.

The surface of Earth changes.

Soils consist of minerals (less than 2 mm), organic material, air and water.

Water circulates through soil changing the properties of both the soil and the water.

Scientific Inquiry Abilities

Identify answerable questions.

Design and conduct an investigation.

Use appropriate tools and techniques including mathematics to gather, analyze, and interpret data.

Develop descriptions and explanations, predictions and models using evidence.

Communicate procedures and explanations.

Time

One class period

Level

Beginning

Materials and Tools

(for each team of 3-4 students)

Clear 2 liter bottle

Three 500 mL beakers* or similar size clear containers marked off in cm to pour and catch water

Soil sample (Bring in 1.2 L samples of different types of soil from around the school or from home. Possibilities include top soil (A horizons), subsoils (B horizons), potting soil, sand, soils that are compacted, soils with grass growing on top, soils with clearly different textures, colors, or structures)

Fine window screen or other fine mesh that does not absorb or react with water

(1 mm or less mesh size)

Water

Clock or timer

Note: Smaller containers may be used if desired as long as the soil container sits firmly on the water catchment container. Reduce the amounts of soil and water - but remember that it is important for all students to start with the same amount.

*You can use 1- and 2-liter bottles and beakers (either 400 or 250 mL) or you can use bottles to act as beakers. See the Just Passing Through Learning Activity at: <http://www.globe.gov/web/soil/documents>.

For more advanced students:

pH paper, pen, or meter

Prerequisites

None

GLOBE® 2014

Just Passing Through (Beginner) Learning Activity - 1

Soil (Pedosphere)

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

Just Passing Through (Beginners Version)

Overview: Students time the flow of water through different soils and observe the amount of water held in these soils. They will also observe the filtering ability of soils by noting the clarity of the water before and after it passes through the soil.

Student Outcomes:

- Students will be able to identify the physical and chemical changes that occur as water passes through soil.

Why Do We Study Soil? Learning Activity



Purpose

To introduce students to the importance of soil and why it needs to be studied

Overview

In the first activity, students generate a list of why soils are important. In the second activity, students are asked to describe the five factors that form a unique soil profile and to explore these concepts. In the third activity, students are shown a demonstration of how much soil there is on Earth that is available for human use.

Student Outcomes

Students will understand the importance of soil science.

Students will be able to provide reasons for studying soil.

Students will understand how soil properties are determined by the five soil forming factors.

Students will appreciate the relative amounts of usable soil that exist on Earth.

Science Concepts

Earth and Space Sciences

Earth materials are solid rocks, soil, water, biota, and the gases of the atmosphere.

Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants.

The surface of Earth changes.

Soils are often found in layers, with each having a different chemical composition and texture. Soils consist of minerals (less than 2 mm), organic material, air and water. Water circulates through soil changing the properties of both the soil and the water.

Physical Sciences

Objects have observable properties.

Life Sciences

Organisms can only survive in environments where their needs are met.

Earth has many different environments that support different combinations of organisms.

All populations living together and the physical factors with which they interact constitute an ecosystem.

Scientific Inquiry Abilities

Identify answerable questions.

Design and conduct an investigation.

Use appropriate tools and techniques including mathematics to gather, analyze, and interpret data.

Develop descriptions and explanations, predictions and models using evidence.

Communicate procedures and explanations.

Time

One or two class periods (depending on level of exploration for second activity)

Level

All

Materials and Tools

Apple and small knife (or diagrams or overhead materials of apple activity)

Soil medicine examples (e.g. diarrhea medicine, antibacterial gel or cream, facial masks)

Soil art examples (e.g. mud cloth, sand painting, pottery)

Soil building material examples (e.g. red brick, photos of adobe and Earthship houses)

Makeup (e.g. foundation, blush)

Soil samples (if available, especially soils that match the colors or textures of the medicine, art, building material, or makeup examples)

Plant

Soil story example (e.g. Maryland Flood Plain Soil)

Prerequisites

None

Welcome

Introduction

Protocols

Learning Activities

Appendix

GLOBE® 2014

Why Do We Study Soil? Learning Activity - 1

Soil (Pedosphere)

Source: [GLOBE Website](#)

[Why do We Study Soil](#)

Overview: Introduce students to the importance of soil and why it needs to be studied.

Student Outcomes:

- Understand the importance of soil science
- Be able to provide reasons for studying soil
- Understand how soil properties are determined by the five soil forming factors
- Appreciate the relative amounts of usable soil that exist on Earth
- Soils have properties of color, texture, structure, consistence, density, pH, fertility; they support the growth of many types of plants
- The surface of Earth changes